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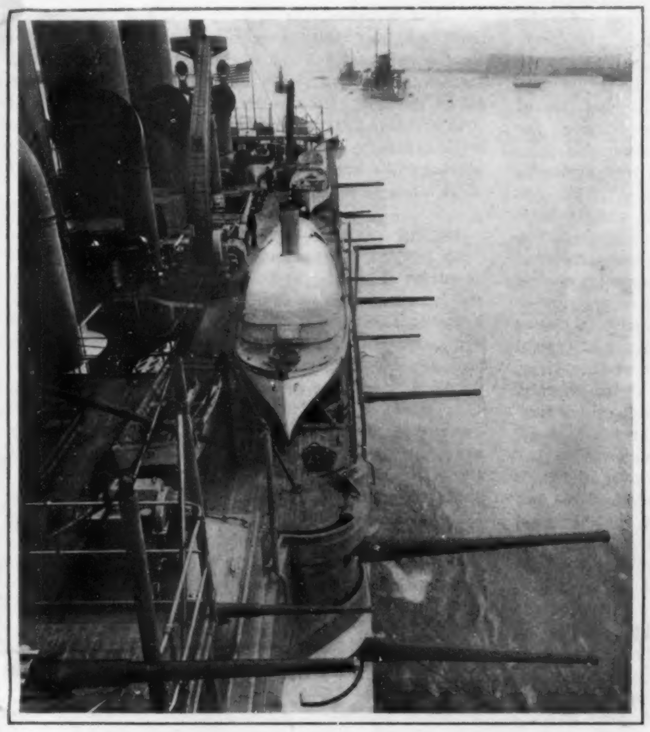
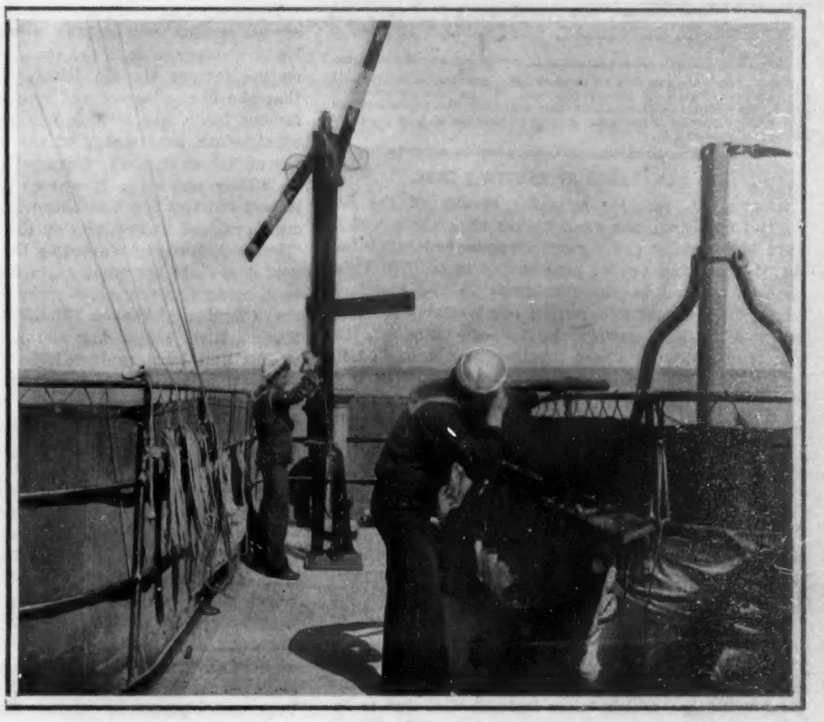


Looking Aft from Flying Bridge of the "Pennsylvania," Showing Broadside Battery of 6-inch and 3-inch Guns.



The upper arms represent the arms of a man. They can be moved through 300°. Each position represents a letter.

Semaphore Signaling System on the Flying Bridge

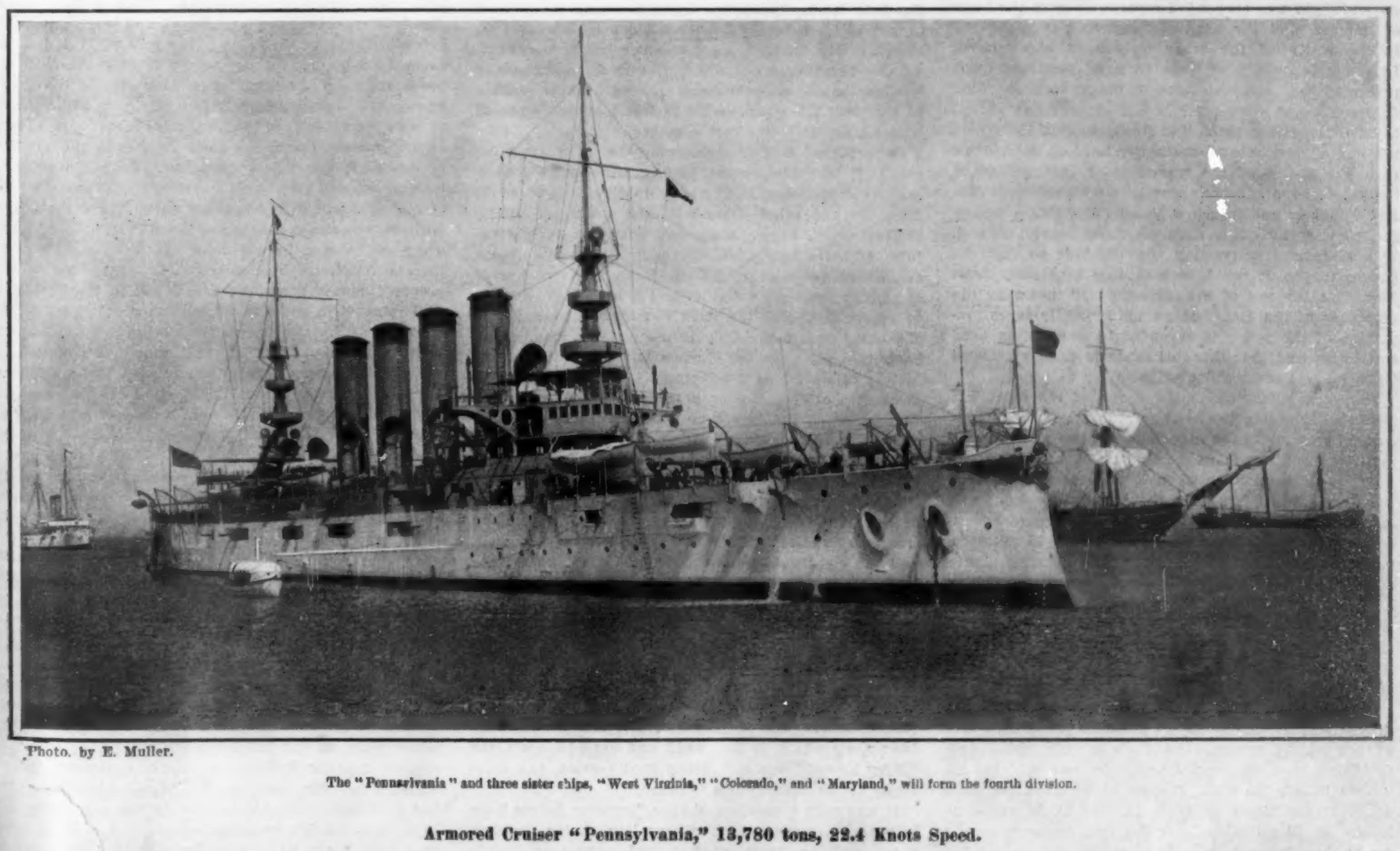


Photo. by E. Muller.

The "Pennsylvania" and three sister ships, "West Virginia," "Colorado," and "Maryland," will form the fourth division.

Armored Cruiser "Pennsylvania," 13,780 tons, 22.4 Knots Speed.

THE REVIEW OF THE ATLANTIC FLEET BY PRESIDENT ROOSEVELT.—[See page 155.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, SEPTEMBER 1, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

AIR RESISTANCE OF ELECTRIC CARS.

Among the valuable scientific results of the St. Louis Exposition, few rank higher than those which were obtained by the various commissions appointed for the carrying out of engineering tests. We have already referred in these columns to the excellent work of the locomotive testing plant established and operated by the Pennsylvania Railroad Company, the results of which have been tabulated and published in book form. An equally valuable work was that carried on by the Electric Railway Test Commission, whose work covered very broadly the field of electric traction. Among other tests was a series which was carried out on a straight stretch of track belonging to the Indiana Union Traction Company; and among these was included a series of experiments on atmospheric and train resistance, which were conducted with an air-pressure dynamometer car, designed by members of the commission especially for this purpose.

The resistance due to the pressure of the air on the front of the vestibule and car body was registered for speeds which varied from 25 to 70 miles an hour. Care was taken in these measurements to separate the resistance of the car due to the atmosphere from the total resistance, which latter includes that due to internal friction and to the rolling friction of the wheels on the track. In order to obtain a separate record of air resistance, the car body was so suspended above the trucks that the pressure on the car could be measured separately by suitable dynamometers. Furthermore, the vestibule was suspended separately from the body of the car, and the head-on pressure was registered independently of the other resistances encountered. In order to determine what form of vestibule front presented the least resistance to the atmosphere, four different forms were used in the experiment: First, a vestibule with a plain, flat front; second, the standard curved vestibule as ordinarily used on interurban cars, the radius of the curved front being 5 feet 6 inches; third, a parabolic vestibule with a length of 6 feet 3 inches; and fourth, a vestibule having a wedge-shaped extension of the parabola 2 feet beyond its end. The wisdom of suspending the vestibule so that the pressure upon it could be measured separately from that upon the rest of the car body was shown by the discovery of the fact that an unexpectedly large proportion of the power is expended in overcoming head resistance, and that this resistance is greatly reduced when tapered ends are substituted for flat ends.

The great effect which the shape of the front end has in determining the head-on atmospheric resistance was shown early in the experiments, when it was found to be impossible to drive the test car at a higher speed than 50 miles an hour when it was carrying the flat front end, although when a parabolic wedge front was substituted, the same motor and the same current were easily able to drive the car at a speed of 75 miles an hour. It was proved in the tests that the atmospheric resistance on the rear vestibule of the car was due to a suction, the effect of which was, of course, to retard the car. With a vestibule of the standard shape at the rear, the power absorbed by the suction of the air was found to amount to 16 horse-power at a speed of 60 miles an hour.

The general results obtained by the commission proved that at all speeds the pressure per square foot on the parabolic wedge vestibule is only about one-fourth of that on the flat vestibule, and that for all shapes tested, the unit pressure at 80 miles per hour is about ten times as great as that at 20 miles an hour. At 60 miles an hour the unit pressure on the wedge-shaped vestibule is 2.10 pounds, and on the flat vestibule 8.20 pounds. At 20 miles per hour the flat vestibule recorded a unit pressure of 1.4 pounds; whereas at 80 miles per hour the corresponding pressure worked out at 14 pounds. On the other hand, on wedge-shaped vestibules the pressure was 0.4 pound at 20 miles an hour and 4 pounds at 80 miles an hour.

These experiments would seem to demonstrate conclusively the advantage of the pointed front and rear, not merely for electric cars but for all swiftly-moving vehicles. In this it is in agreement with the celebrated Berlin high-speed tests, which clearly demonstrated the value of the tapered front. The Bavarian state railways have built their recent express locomotives with tapered casings on the various parts of the engine that are exposed to head-on air resistance, and our readers will have in mind our recent illustration of the Union Pacific motor car No. 7, whose shape at front and rear would seem to have been modeled in agreement with the findings of the St. Louis test commission.

GROWTH OF THE HUDSON RIVER STEAMBOAT.

There were several facts that conspired to make the recent maiden trip of the new steamer "Hendrick Hudson" memorable in the annals of steamboat history on the famous Hudson River. Apart from the fact that she is the largest and swiftest of a long line of famous boats, her maiden trip was completed on the ninety-ninth anniversary of the ever-memorable journey of Robert Fulton's "Clermont" from New York city to Albany and back. It was on August 17, 1807, that Robert Fulton's epoch-making trip began, and the little craft returned successfully on the 21st of August. The "Hendrick Hudson" started on the 20th and, returning next day, made her landings, in New York city, exactly on the ninety-ninth anniversary of the completion of the "Clermont's" voyage. The steady growth in size of Hudson River steamers is shown in a study of typical vessels that have navigated the waters of this river.

The "Clermont" of 1807 was 133 feet in length only, or but one foot longer than the America's cup-defending yacht "Columbia." The "Chancellor Livingston," built in 1816, was 154 feet in length; and the "Erie," constructed sixteen years later, had an over-all length of 180 feet. The "Rochester," which measured 209 feet from stem to stern, may be taken as a typical vessel of the year 1836. Twenty-four years later, at about the time of the outbreak of the civil war, that famous old craft, the "Daniel Drew," was placed in service, a vessel which will be familiar even to many of the younger readers of this journal. In this steamer the over-all dimensions had risen to 251 feet. The most marked advance in size and comfort was undoubtedly made when the two sister ships "Albany" and "New York" were placed in service. Each of these was 325 feet in length and they had no difficulty in maintaining an average speed of over 20 miles an hour. The "Albany" was placed in service in 1881, and the "New York" six years later. The last-named vessel, after running successfully for over a decade, was taken to the Erie Basin, Brooklyn, cut in half and lengthened to 350 feet. In the "Hendrick Hudson" the over-all length of the Hudson River steamer has been carried for the first time up to 400 feet, with a corresponding increase in the other dimensions, the boat measuring 82 feet over the guards with 14 feet 4 inches depth of hold and a draft of 7 feet 6 inches.

In the broad field of engineering there are few products that bear such strong individuality as the American river steamboat. There is nothing like it to be found in any other country in the world. With its shallow draft, broad beam, and towering superstructure, with its long lines of amply-lighted staterooms and wide expanse of promenade decks, the typical river steamboat possesses a dignity and grace which combine to render it one of the most picturesque creations of the naval architect. This is particularly true of the boats that ply upon the Hudson River. In the earlier history of steamboat development, iron was scarce and good shipbuilding timber plentiful. But it was soon found that as the length and weight of the boats increased, it was necessary, on account of the great shallowness of the hull, to provide some method of trussing by which the boats could be held to their true sheer line and prevented from "hogging," or the sagging of the bow and the stern. Hence those remarkable trusses extending parallel with the keel of the boat, and the elaborate system of tie-rods leading from the hull to a row of central posts erected upon the keel of the ship. Another characteristic and decidedly picturesque feature was the curious walking-beam engine, whose low speed of revolution necessitated the construction of paddle wheels truly gigantic in size. In the earlier boats, moreover, the boilers were carried upon the guards and outside of the hull of the vessel; indeed, several fine old boats of this description, notable among which is that swift and graceful craft, the "Mary Powell," are still doing good service, and seem likely to for many years to come.

It was only a question of time, however, before huge stiffening trusses, multitudinous hog chains, cumbersome walking beam engines and ponderous paddle boxes would have to give way to more modern and scientific methods of construction—indeed, it is surprising that these makeshift methods, rendered necessary by the conditions of a long bygone day, should have survived in one or two notable vessels which have been built for night service on the Hudson River within the last few years. In the "Hendrick Hudson," however, steel has taken the place of wood in the construction of the hull; low-pressure boilers and cumbersome walking-beam engines have disappeared, and their place has been taken by compact, high-pressure boilers, and inclined direct-acting engines placed below the main deck of the steamer. The result of these changes is that practically the whole of the ship above the main deck is devoted to passenger accommodation and the decks are no longer obstructed by the capacious well which formerly housed in the A-frame, connecting rod, piston, and the gear of the old walking-beam type. The result, looking at the ship from the broadside, is a decided gain in smartness and general symmetry of appearance. The addition of another deck, bringing the total decks up to five, has increased the capacity, until it is estimated that 5,000 day passengers could be carried. On the maiden trip some 4,000 were accommodated without any discomfort from crowding. The speed of the vessel on the trial trip was 23.7 land miles per hour, and it is probable that when the engines, which are of the triple-expansion three-cylinder type, have worn to their bearings, the boat will be good for a maximum speed of 24 miles an hour.

CEMENT BASES FOR WOODEN TELEGRAPH POLES.

Up to date, wooden telegraph poles remain in most countries the cheapest in first cost and in many respects as desirable as any. The question of durability, however, has been a sore point to those in charge of equipment and maintenance. All sorts of preservative solutions and all kinds of treatment therewith—pressure, vacuum, a combination of the two, etc., have been tried, but the wooden mast still remains more perishable than the iron, and its renewal means an expensive piece of work, outside of the cost of the pole itself. Happily, however, a new idea has been evolved from the depths of some one's moral consciousness or the heights of his inventive faculties, and according to which not only new wooden poles may be made more durable, but those which are already rotten at the base may be utilized to advantage and given a longer second life than the first. What is particularly gratifying to telegraph and telephone companies is the fact that this process is not patented, and from the point of view of first cost not too burdensome.

The process consists in mounting the pole in a socket of cement beton, with which, however, it does not come in direct contact. When we say "in a socket" we err in the matter of technical accuracy; for in the later forms of mounting there is a space between the foot of the wooden pole and the top of the cement base. The pole is attached to the base by four iron splice-plates or fish-plates. The cement base stands 8 to 10 inches above the ground level, and is a prism of the same diameter as the pole which it has to carry. On account of the severe leverage tending to break it off, it is strengthened with iron in the well-known manner of Monier or Coignet. The attachment of a wooden pole to such a foot takes only about twenty minutes; and the same is true in the matter of replacing one pole by another. To put a cement base on an old pole with a rotten foot the latter is sawed off about 8 to 10 inches above the ground and without removing the wires lifted a couple of feet away and leaned to one side; the old rotten foot is then removed, the hole somewhat enlarged, the ready-prepared cement stump or base is set in the hole and well rammed in and the old pole then attached to the cement base by the fish-plates, leaving say two inches between the two. The life of a pole thus mounted is reckoned at sixteen years. As regards the resistance of the cement base to breakages—that has been settled beyond question by the simple means of attaching a rope to the top of several poles and pulling horizontally thereon until something gave way. That "something" was in every case the wooden pole, and the break took place in every instance just where it was expected, namely, right above the cement base, or rather the fish-plate.

The bases are molded in a plain prismatic box, well rammed in, and left two or three days in the mold to set; they are then firm enough to handle without danger of injury. The bases are left to dry another week after removing them from the mold.

The first application of the multiple-unit system of railway motor operation and electrical control to motors of the alternating-current commutator type will be made soon on the suburban extensions of the Milwaukee Electric Railway and Light Company, one of which is 20 miles and the other 16 miles long. According to Power, the motors will be the "combination" type for operation on either alternating or direct current. Each car will be equipped with four 75-horsepower motors. The electro-motive force on the alternating-current overhead lines will be 3,300 volts, and transformers on the cars will reduce this to the proper voltage for the motors.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

If we look directly upward early on a clear September evening, we will see the heavens just as they are shown on our map. Right above us is the fine constellation of the Swan—a great cross of stars in the Milky Way. West of it, and near to it, is the Lyre, with one very bright star, Vega (marked with the letter α on the map).

Following down the Milky Way to the southwest, we come to the Eagle (Aquila), whose brightest star, Altair, is nearly equal to Vega. Below this is the brightest and finest part of the Milky Way, which is almost startlingly brilliant on a thoroughly clear night. Even an opera glass shows that it is full of groups and clusters of stars, and those who have telescopes, of whatever size, will find it a happy hunting ground, full of magnificent fields. It extends far down to the southwest, where the constellations of the Scorpion and the Archer are beginning to set.

In the western and southwestern sky are the Serpent Holder (Ophiucus) and the Serpent, which, like Hercules to the north of them, can be studied better from the map than from any description. Below Hercules is the Northern Crown, and beneath this the Herdsman, with the great red star Arcturus. The Dragon and the Little Bear are to the left of the Pole, and the Great Bear is below them, so that the Dipper lies along the northwestern horizon. Cepheus and Cassiopeia are on the right of the pole and above it, toward Cygnus.

East of the Milky Way stretches a row of fine constellations. Due east, and about half-way up to the zenith, is Pegasus, which can be known at once by the "great square," whose four stars are all of the second magnitude. The northeastern one belongs not to Pegasus, but to Andromeda, which extends far to the northward and eastward. Still further on in the same direction we reach Perseus and then Auriga, the Charioteer, whose brightest star, Capella, is just rising.

The most interesting object in Andromeda is the great nebula, which is marked on our map, a few degrees northwest of β Andromeda. It is visible to the naked eye, and conspicuous in a field glass, but the marvelous concentric spirals which form its outer portions are revealed only by photography.

Below Andromeda is the small group of the Triangle, and the smaller but brighter one which marks the head of Aries, the Ram.

The Zodiacal constellations of the Fishes (Pisces), the Water Bearer (Aquarius), and the Sea Goat (Capricornus), which lie in the southeastern sky, contain no bright stars. The planet Saturn is now in Aquarius, and is much brighter than any star near it. It lies almost on the line of the western edge of the great square of Pegasus, extended southward. Farther down, in this same line, is a solitary bright star, Fomalhaut, in the Southern Fish.

THE PLANETS.

Mercury is morning star at the beginning of the month, rising at about 4:30 A. M. On the 4th he is in conjunction with Mars, passing him at a distance equal to one-third of the moon's apparent diameter. Both planets are near the bright star Regulus and soon pass north of it at a distance of less than a degree.

During the latter part of the month Mercury is invisible and on the 24th he passes behind the sun and becomes an evening star.

Venus is evening star in Virgo, and is very bright. On the 20th she is at her greatest elongation—that is, her apparent distance from the sun is greatest. She is, however, far south of the Sun, and is not nearly as conspicuous as at a spring elongation, but sets at about 8 P. M.

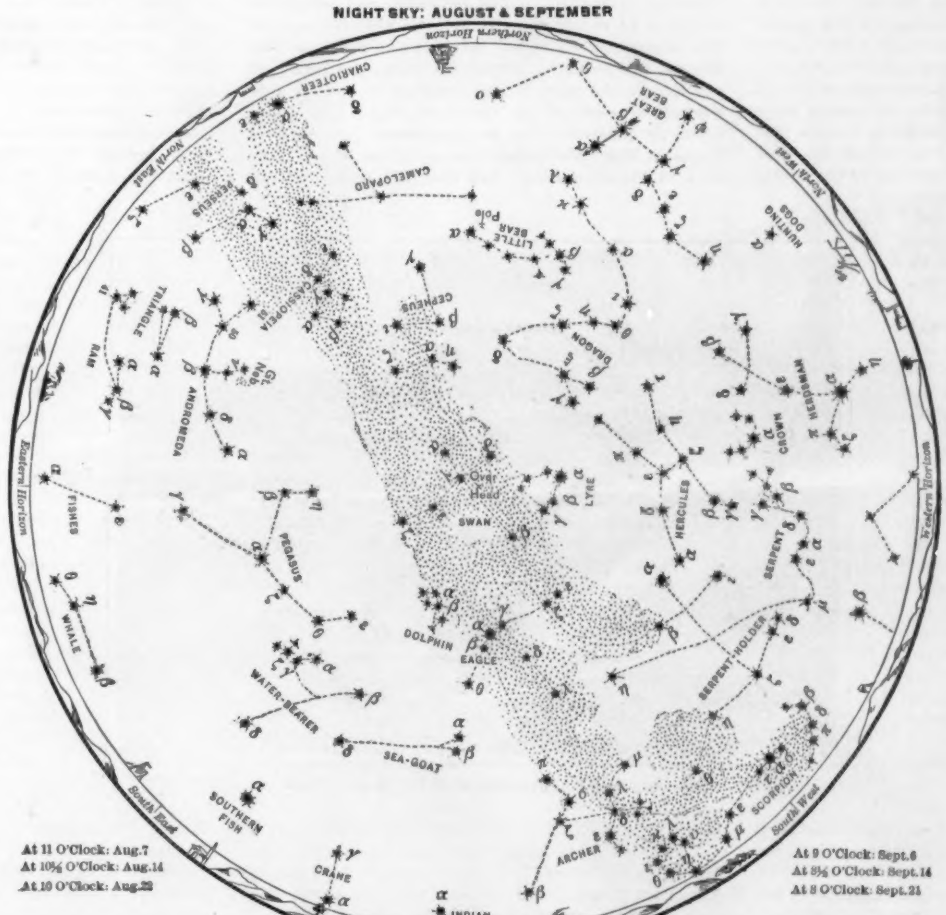
Mars is morning star in Leo, rising about 4:30 A. M. Jupiter is in Gemini, and rises near midnight in the middle of the month.

Saturn is in Aquarius, and comes to opposition on the 4th. He is now in a better position for observation than for several years past, and will well repay any one who turns a telescope upon him. The Earth is getting near the plane of his rings, so that we see them much more nearly edgewise than last year. A few years ago they appeared as an oval about half as wide as it was long. Now the length of the ellipse is ten times its breadth, and the rings seem to stick out on each side of the ball of the planet like handles. In another year we will see them edgewise, and they will then disappear entirely, except in very powerful telescopes, to broaden out again in the year following, when we see their opposite side.

The brightest of Saturn's nine satellites, Titan, may be easily seen with a small telescope. It is west of the planet on the 5th and 21st, and east of it on the 13th and 29th (its period being sixteen days). When it is north or south of the planet it now seems so close to it (less than the planet's diameter) that it will be hard to see it with a small instrument.

Uranus is in Sagittarius and is in quadrature on the 28th, coming to the meridian at 6 P. M. Neptune is in Gemini and can be observed before sunrise.

NIGHT SKY: AUGUST & SEPTEMBER



At 11 O'Clock: Aug. 7
At 10½ O'Clock: Aug. 14
At 10 O'Clock: Aug. 22

At 9 O'Clock: Sept. 6
At 8½ O'Clock: Sept. 14
At 8 O'Clock: Sept. 21

At 9½ O'Clock: August 29

In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE MOON.

Full moon occurs at 6 P. M. on September 2, last quarter at 4 P. M. on the 10th, new moon at 7 A. M. on the 18th, and first quarter at 1 A. M. on the 25th. The moon is nearest us on the 21st, and farthest off on the 9th. She is in conjunction with Saturn on the 2d, Jupiter and Neptune on the 12th, Mars on the 16th, Mercury on the 17th, Venus on the 21st, Uranus on the 24th, and Saturn again on the 30th.

The conjunctions with Saturn are close, and occultations are visible in the southern hemisphere.

At 6 P. M. on the 23d the sun crosses the celestial equator and enters the sign of Capricorn, and in the old expression of the almanac, "autumn commences."

THE USE OF CLAY CONES IN STEEL HEATING.

The days of estimating the heat of a work-piece by the color have gone by—at least in establishments where any weight is laid on uniformity of product. In the first place, no two men will agree as to the color of a piece in any one fire or bath; in the second, the same temperature will be differently estimated in different parts of the shop or at different times of the year—or even day; and in the third place (what is of equal importance), no two steels will show the same color for the same temperature. Something more exact must take the place of the eye. There are some good pyrometers, but they are generally expensive and delicate, and inconvenient to apply. But there is a means of measuring—not estimating—temperature, which manufacturers of fine porcelain use, which should be of great value to steel workers in enabling them to ascertain with certainty just what the temperature in a furnace really is, instead of guessing at it. And here we may add what we should have given as fourthly above—that the eye grows tired and less sensitive to color; so that the same temperature will be estimated lower, after ten minutes' watching red or white hot metal or combustible.

The method to which we refer consists in the use of porcelain—or rather clay—cones of various melting or softening points; there are about sixty different grades, each stamped with a number corresponding to a definite temperature at which slumping down takes place. The range of temperature is between 590 deg. and 1,940 deg. C., or say 1,094 to 3,524 deg. F.

In order to find out which cones to use, where the right temperature is not known in degrees, the first test is made with several cones, and that one is chosen as the standard which at the desired temperature curls over and nearly or quite touches the floor of the furnace. It is best to use two cones of the proper number, one for the hottest and the other for the coolest part of the furnace; their curling over is to be watched through the usual peep-holes, preferably covered with mica. The cones should be protected from direct flame, just as much as the workpieces are. A good way is to fence them around with two bricks on the side and one on top, the cone also standing on a brick. Another way is to use open-sided clayware hoods provided for the purpose, and which melt at a higher point than any of the cones. There are also small muffles which serve the same purpose, as well as capsules with lids; these latter, of course, must be drawn from the furnace in order to observe the cones.

Just why the cones now used are not marked with the melting temperatures instead of numbers ("022," "09," "29," etc.), "deponent saith not, not knowing"; perhaps some wire-gage manufacturer can give the reason.

"GALVANIZING" WITH ZINC-ALUMINIUM ALLOY.

In order to get a "galvanizing" bath that shall be quite liquid and yield a brighter surface than is attainable by the use of zinc alone, Gührs uses an alloy composed of about one-half of one per cent of aluminium, and one-fifth per cent of bismuth with the zinc. In order to get this alloy in proper state of diffusion it is necessary to melt the aluminium at the same time with the zinc; the bismuth can be melted in at the same time if desired. It is claimed that simultaneous melting of the zinc and the aluminium prevents the formation of oxide and of hard dross. In order to effect this desirable simultaneous melting of these two metals, it is best to prepare beforehand an alloy of zinc and aluminium, or of these with bismuth, in stronger proportions of aluminium than is desired in the bath—for instance, 20 parts of aluminium and the same of zinc, with 5 of bismuth, well stirred while melting. This "mix" is to be melted with the rest of the zinc, in such proportions as will give to the resulting melted mass the requisite proportions for the bath.

A higher percentage of aluminium can be used than one-half (one two-hundredths of the entire weight), but it effects no improvement above that brought about by the use of the smaller quantity. The bismuth may be used in even smaller quantities than the above-quoted one-fifth of one per cent.

An American patent has been granted for making pens of tantalum or its alloys.

SANITATION OF THE CITY OF WASHINGTON.—I.

BY BEN. WINSLOW.

THE AQUEDUCT AND FILTRATION PLANT.

The average annual death rate of the city of Washington, according to the Twelfth Census, is with one exception the highest of all the cities of the United States having a population of over 100,000. The average annual death rate of Washington for the period covered by the last census is 23.09 per 1,000 population, while the average for cities of approximately the same size is about 17 per 1,000. In the table of annual death rates per 100,000 population due to typhoid fever in cities of the same class, Washington stands first with 78, which is 20 higher than Cleveland, the next highest city on the list. The capital city of the nation is now nearing the end of a costly effort to reduce its abnormally high death rate to a more reasonable figure, and the work has been done so quietly that the citizens know little of it.

Long before the city even dreamed of a filtration plant; before the use of any filters for water, except probably inadequate and unsatisfactory individual devices, the city of Washington struggled with the momentous question of pure drinking-water supply. Major L'Enfant, under the direction of Gen. Washington, made numerous surveys, to "ascertain the practicability of obtaining a full supply of good water for the federal capital," but it was a long time before the idea of bringing the city's water fifteen miles was considered with any degree of seriousness.

The immense volume of water discharged over the Great Falls of the Potomac, situated fifteen miles above the city, marked that place as the future source of water supply many years before those in authority finally obtained the necessary means and sufficient courage to attempt what was then considered an almost impossible task. The expense was the greatest stumbling block to the Great Falls project, the estimated cost being so great that it staggered the young government; and although some surveys were made by order of Congress in 1850, owing to the lack of sufficient funds the Great Falls project was not gone into at any length, the surveys and investigations of the Topographical Corps having been confined to the Rock Creek proposition. Col. Hughes, who reported the results of the surveys, contemplated the building of a dam which would give a supply of about eight million gallons of water from Rock Creek per diem.

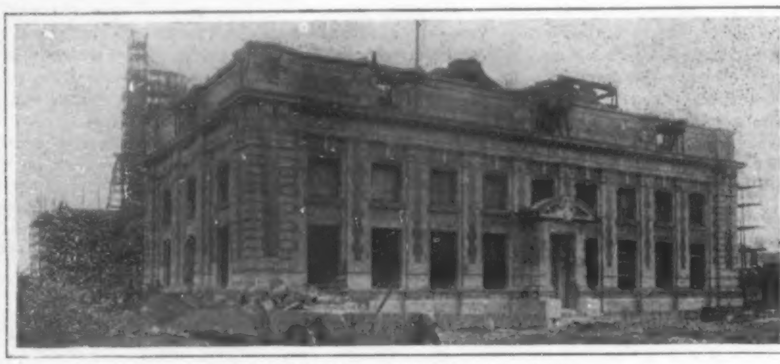
The population of Washington at that time was forty thousand, and this volume of water was considered sufficient to supply the city for the next forty years. The proposed daily supply was one and a half million gallons, or over thirty gallons per capita per diem. In addition to the dam, it was proposed to build a sedimentation reservoir on "Mederian Hill," and a distributing reservoir, "to be established just back of Franklin Road, the highest ground in the city." "Just back of Franklin Road" was then a considerable distance from the city; but now it is in the heart of it.

The Great Falls proposition originated with Capt. M. C. Meigs, of the Corps of Engineers, U. S. A. The Rock Creek project having been discarded, Congress in 1852 appropriated five thousand dollars to "enable the President to devise a plan for supplying the city with an adequate water supply," and surveys were made ove the Great Falls route during the winter of 1852-53. Congress at its next session passed a resolution which put the selection of plans in the hands of the President, and it also voted to defray from the Treasury the cost of any project he approved. The President accepted the Meigs plan, which called for a nine-foot conduit from Great Falls.

To hold the water at a proper level a dam was constructed at Great Falls, with its comb one hundred and forty-five feet above high tide at Washington, and from this dam the water was conducted through a circular conduit of brick, nine feet in diameter and having a fall of nine and one-half inches to the mile. In order to shorten the conduit and save expenses, a receiving reservoir was formed by damming the Little Falls Branch, a tributary of the Potomac, situated about five miles from Washington. With an area of little over fifty acres, it has a capacity of approximately eighty-five and a half million gallons, and is used for both storage and sedimentation. A distributing reservoir was constructed on the heights of Georgetown, about two miles from Washington, and connected with a receiving reservoir by a continuation of the conduit. The system was completed in 1863, and has been in continuous successful operation ever since.

One of the greatest problems that confronted the engineers was the placing of the conduit beneath the rock bluff which skirts the river from a point about a mile and a half below Great Falls to the intake at the dam. All but about a mile and a half of the conduit is laid under one of the finest roadways in the country. It is known as the Conduit Road, and is kept in prime condition by the War Department.

The famous Cabin John bridge, which, until the construction of a rival in Germany, was the largest single-arch stone bridge in the world, carries the conduit over Cabin John Run, and the Pennsylvania Avenue bridge, built on arches formed by the two mains which lead from the distributing reservoir to the city, carries the water over Rock Creek. The greater part of the water, however, now flows through the famous Lydecker tunnel to a reservoir on the heights to the north of the city, from which it is pumped into the new filter beds, and thence distributed throughout the city as pure water.



A Completed Section of the Pumping Station.

Laying the Outfall Sewer Across the Swamp Lands.

The Dry Land Continuation of the Outfall Sewer.

Breaking Ground. An Orange Peel Shovel Beginning the Work of Excavation.

The Portals of the Twin Tunnels Which Cross the River.

SANITATION OF THE CITY OF WASHINGTON.—I.

The Filtration Plant.—The water furnished to the residents of Washington by the water supply completed in 1863 was simply water from the Potomac River, collected in open basins and allowed to settle. To-day water that has been filtered at a cost of $450 a day, in a filtration plant that cost $3,468,405, is distributed through thousands of mains in the city to every fire plug and to the faucets in every house. It is still Potomac River water, but it has been cleaned and "screened" until it is as clear and sparkling as the finest spring water.

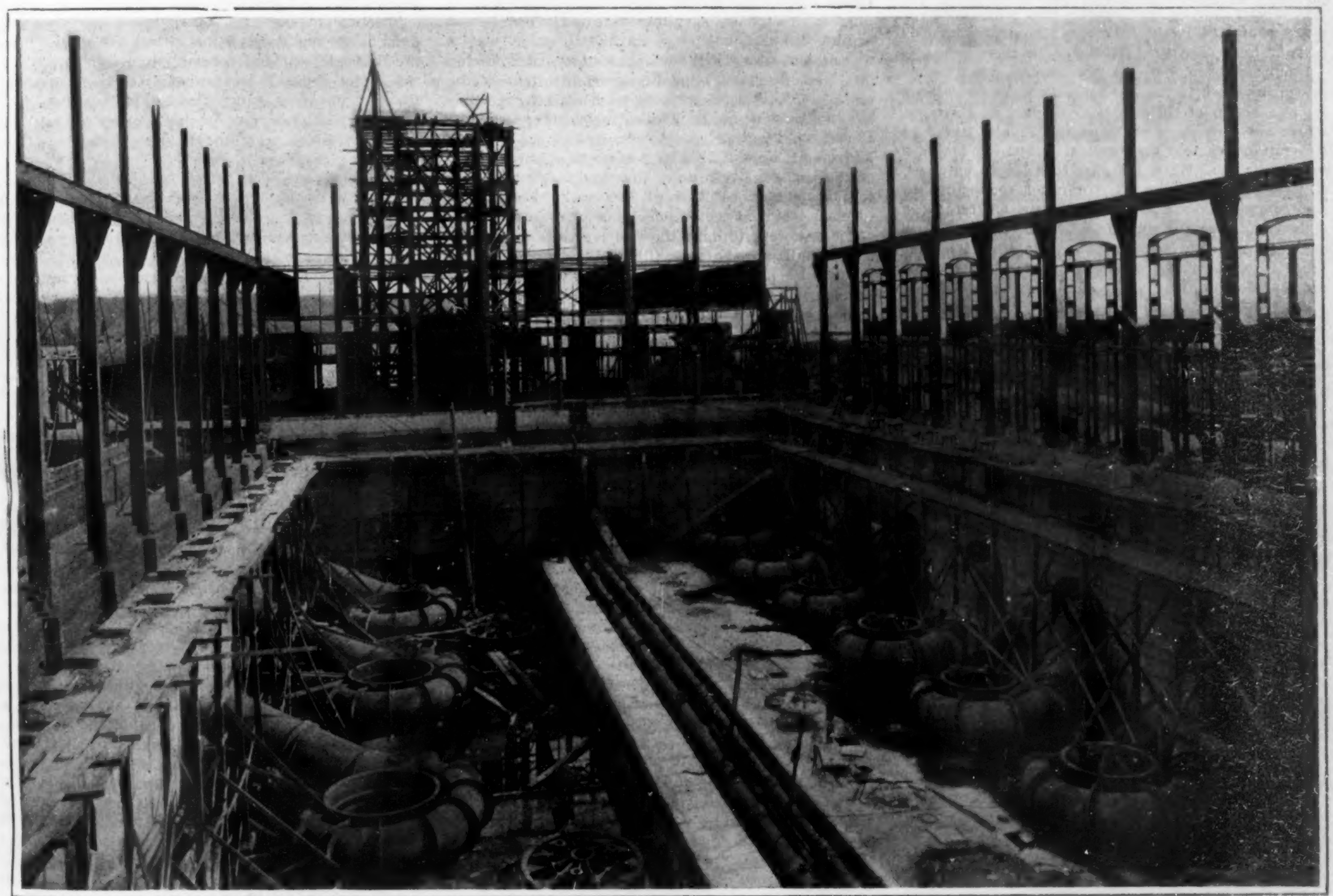
The filtration plant is one of the largest and finest filtration plants in the world. It is of the English or slow-sand type. The American, or mechanical system of filtration, which is considerably cheaper, was originally favored during the early discussion of plans, but owing to strong objection and protests against the use of a coagulant, usually alum, to precipitate the suspended matter, Congress passed an act specifying the English system. The estimated cost of filtration by this system is $6 per million gallons. The plant covers forty-five acres of ground, and in its construction 800,000 cubic yards of earth were removed, every yard by steam shovels. The filtering plant proper is divided into twenty-nine compartments of one acre each, and each bed holds 3,000,000 gallons of water. The filtering capacity of the plant is 75,000,000 gallons of water a day.

The method of filtration is quite simple. Preliminary sedimentation takes place in the Washington city reservoir, situated to the west of and quite near to the filter beds. This reservoir has a capacity of 300,000,000 gallons of water and in it much of the suspended matter is precipitated before the water is lifted by the pumps to twenty-five of the twenty-nine filter beds. The pumps deliver the water to the farthest sand beds, where it flows in at the top. From these it flows into other beds, being gradually cleaned by passing through three feet of clean, sharp sand and one foot of gravel. The water is finally collected by a carefully-planned system of under-drainage and piping and delivered to an inclosed storage reservoir. This reservoir has a capacity of 20,000,000 gallons, or about one-third of the filtering capacity of the plant. It has a cement floor and roof, supported by cement pillars.

The filter beds are thoroughly cleaned every three weeks. To accomplish this without interrupting the plant, only twenty-five of the twenty-nine beds are in operation at a time. The beds are so constructed that the supply of water to any particular bed may be cut off without disturbing the supply to the other beds. The cleaning process is going on in four of the beds all the time. About three inches of the surface is scraped off, and an equal amount of clean sand added. The water is then turned into the bed. The three inches of sand scraped from the surface is not entirely wasted. It is thoroughly cleaned in an elaborate system of sand-washing apparatus, and dried ready for use again. The sand lost in the cleaning process amounts to about five inches a year.

In order to be absolutely sure that the water issuing from the plant is pure, a completely equipped chemical and bacteriological laboratory has been established at the plant, and competent men are continually testing the water. The completed plant now resembles a great pathless park. The site presented a considerable grade toward the city, and the process of leveling left the tops of some of the beds above the street and some below. These were covered with concrete, and on this was packed two feet of earth, and practically the whole tract was sodded.

(To be concluded.)



The Syphon Chamber.

SANITATION OF THE CITY OF WASHINGTON.—I.

A New Electric Lamp.

Consul E. T. Liefeld forwards from Freiberg an abstract from a Paris newspaper concerning a new electric lamp, which it is said will considerably better the present system of lighting. The article was wired from Vienna and reads:

An Austrian chemist, Dr. Hans Kuzel, has, after many years' hard work, succeeded in constructing a new electric lamp, which he calls the Syrius lamp. As is well known, incandescent gaslight is cheaper than electric light, because the carbon filaments of the latter are very expensive and the glass bulbs soon wear out. Doctor Kuzel has now invented a new substitute for the incandescent filament by forming out of common and cheap metals and metalloids colloids in a plastic mass, which can be handled like clay and which, when dry, becomes hard as stone. Out of this mass very thin filaments are then shaped, which are of uniform thickness and of great homogeneity. These two characteristics are of great value in the technics of incandescent lamps.

The Kuzel lamp, it is claimed, uses one-quarter of the electric current which the ordinary electric lamp with a filament wire requires. Experiments, it is asserted, have shown that the lamp can burn for thirty-five hundred hours at a stretch. Another advantage is that the intensity of the light of the new lamp always remains the same, the lamp bulbs never becoming blackened, as is now the case.

A Successful Trial of Santos-Dumont's Aeroplane.

Santos-Dumont's novel aeroplane, which we illustrated in our last number, and with which this well-known experimenter has been making tests by suspending it from one of his dirigible balloons and also by attaching it to a trolley running on a rope hung from two elevated points, had its initial test in a field near Paris early on the morning of August 23.

Carrying its noted inventor in the basket, the aeroplane, propelled by a 24-horse-power, 8-cylinder, V motor, skimmed along the ground on its wheels from one end of the field to the other and back again. Several times, during the run, it raised itself off the ground a short distance. Imperfect operation of the motor was given as the reason the machine did not soar; but from the photographs and dimensions of the propeller it would appear that this was also one of the main reasons. The propeller is much too small, apparently, to be capable of exerting much thrust, and a very considerable thrust (300 or 400 pounds) is necessary to elevate a machine of this kind.

After it gets in the air, moreover, the question of stability is a grave one. On account of the dihedral angle of the planes, Santos-Dumont's aeroplane should, however, have much better transverse stability than that used by the Wright brothers.

Road-tarring on a large scale has been seen in France during the preparation for the Grand Prix race. The tarring is carried out on the Lassailly system by the use of the most improved apparatus for heating the tar and applying it to the surface of the road. Commenced on the 25th of May, the operation lasted scarcely ten days for the 500,000 square yards which were covered, employing two gangs, each made up of six drivers and eight horses, together with eight men for spreading the tar, counting the men needed for sanding the road after the tarring. A fine road is the result of this operation, and it shows that by the use of the proper apparatus a large extent of road can be treated within a short time and with a small amount of labor. At the last moment the excess of sand which covers the layer of tar will be swept off by the four sweeper wagons employed by M. Lassailly, when the cars will be able to run under ideal conditions. Such a process, far from being an extra expense, is now recognized as an actual economy, seeing that the cost of keeping up the road becomes much less, and this pays for the tarring expenses, and may even exceed the latter, as has been found during a long series of observations made in France.

Correspondence.

"Fibered Cement" or Reinforced Concrete?

To the Editor of the Scientific American:

Would not "fibered cement" be a more fitting name to give to this new building material combination than "reinforced cement"? To the uninitiated this means a cement strengthened by the admixture of some other substance of like nature; one would hardly think that iron rods were used, and as these really form a fiber running through the cement, "fibered cement" would seem to be more appropriate, beside being easier to speak and write. In fact, would it not be as correct to say "reinforced iron" as "reinforced cement," as each substance strengthens the other about equally?

In this connection I want to suggest the use of bamboo, either the whole cane or split into strips. It is cheap, light, strong, and durable, and, I believe, does not swell when subjected to moisture, consequently there are many cases where it could be used in place of iron. Charles J. Sands.

Pasadena, Cal., August 7, 1906.

Dr. Wiley on the Pure Food Law.

To the Editor of the Scientific American:

It is only fair to your readers that many misstatements contained in the article on "Adulterated Food" in your issue of August 18 should be corrected.

I suppose that not one of your readers would be deceived in regard to the law by what was said respecting the action of the Senate, inasmuch as a law requires the concurrent action of the Senate, House of Representatives, and the President. Mr. Landon says in this article: "When the pure food law is enforced, it will compel the manufacturers of food stuffs to label their products." This is quite an erroneous statement, since the pure food law does not require anybody to label his products. It simply requires that products when labeled shall be correctly labeled, that compounds, imitations, and blends shall be so marked.

Mr. Langdon writes a great deal of covering for the kernel of his article, which is to induce the people to think that borax and boric acid are permitted preservatives, but this is not the case, as is shown by the recent regulations for the enforcement of the meat inspection act, in which all preservatives, with the exception of sugar, salt, spices, vinegar, wood smoke, and, pending further investigation, saltpeter, are prohibited. It is not likely that the regulations for the enforcement of the pure food law will contradict the meat inspection regulations. I may say, for the further information of your readers, the pure food law does not mention borax. It does permit the application of preservatives externally to food products when preparing for shipment, but if any of these preservatives should enter the substance itself, it could not be used under this provision. The same clause also requires that directions for removing the preservative before the food product is eaten shall accompany each package, thus specifically recognizing their harmfulness. Borax and boric acid, which, as stated by your correspondent, are allowed by the United States Senate to be used on meats, fish, and fowl, if used at all can only be used at the time of packing, only externally, and only when they are necessarily removed, and only when directions for such removal accompany each package. This does not seem to be in harmony with Mr. Langdon's statements.

Mr. Langdon is a very prolific writer on this subject and in every one of his communications the sole object in view is to secure the recognition of the use of borax and boric acid in foods. The latest work on this subject, namely, "Diet in Health and Disease," by Dr. Julius Friedenwald and Dr. Ruhräh, of the College of Physicians and Surgeons, Baltimore, Md., says:

"Borax and boric acid as preservatives are the subject of numerous conflicting opinions. It is possible that some of the favorable opinions have been issued by those who draw their salaries and their opinions from the same source. While it is stated by many that the use of these chemicals is not injurious, there are instances on record where they have caused severe symptoms and even death." H. W. Wiley.

Washington, August 23, 1906.

The Moth and the Flame.

To the Editor of the Scientific American:

The March 10 number of the Scientific American has an article on "The Moth and the Flame," which tempts me to recount some observations and experiments in this matter.

I will begin with the mosquito, which is a night flier, and yet pays no attention to the flame. In illighted Chinese houses it will steal up for a bite any time of day; but in our dwellings it prefers a warm evening after lamps are lighted. One morning I smudged my study with some insect powder placed over a lamp, and I killed mosquitoes by the score as they danced around on the panes of the sunlit windows just as crazily as ever did a moth around a lamp. The same experiment also brought to the windows a dozen or more clothes moths, that usually avoid the light, and lurk in folds of garments or in chests and boxes; but the smudge made them want to get out, and they flew to the windows, and settled down on the panes just as flies do when they try to go through a window and are stopped by the glass.

But the honey bee will fly the hardest at a window pane by day or a lamp by night. It gathers honey in the brighest sunlight; but deposits it in a dark hive, in which lightward always means outward—exit—while darkward means inward. This has been their unchanging experience for untold generations. Bees frequently come into the house, and as the windows are the best-lighted parts of the walls, they try to go out through these instead of the door at which they came in.

One such bee began so late in the day that the twilight found it still vigorous; but as the window grew darker it gradually relaxed its efforts, and finally left the glass for the white jamb, still buzzing occasionally. After supper I set a shaded lamp on the window sill, and the bee flew at the lamp chimney several times, but each time it instantly recoiled from the heat. Once, however, it flew up against the bright nickel-plated base of the burner, and buzzed against it for a number of seconds, just the same as it had buzzed against the window pane by daylight.

Once, when I opened the window to let out a buzzing bee, a partly-closed blind prevented the light of the crack between sash and casing from reaching the bee; but there was a line of light on the jamb opposite the crack. The bee continued to buzz against the pane till I covered it up, and then it flew to the streak of light on the jamb, and tried to go through that; and then it turned and flew out through the crack. Next day I found a moth on the window, and when the window opened, it went through the same motions as the bee had, clinging to the ~~ne till this was covered, then flying to the streak of light, and then at last going out through the crack.

Thus we see that under like conditions moth and bee behave alike; but a part of the moth's "craziness" is due simply to its zigzag manner of flight. In not a few cases where I have seen a moth fly into the flame of my clock lamp, it has been due to its zigzagging while circling around the blaze. There is also one potent element in the situation at night which is wanting in the daytime. Set a lamp in an open window at night, and note how black it makes the darkness appear. It is such a blackness as would ordinarily indicate a solid obstacle; and so when a night flier comes within the range of the light, the darkness seems to it to become a solid wall inclosing it on every side, with no outlet except toward the light. Hence it is that on a warm evening, with windows and blinds wide open, moths begin to come in; but they rarely go straight to the lamp. Many of them go first to the white wall, and afterward come nearer and nearer to the lamp; but most of them settle down at last on the walls, and remain there motionless the rest of the evening. In a dingy Chinese house the lamp attracts more directly to itself than it does in our white-walled houses.

One evening I found in my bedroom a young sparrow, which instead of flying at the window panes as it would have done in the daytime, flew at the white jambs and at the white walls. When I cornered it with a shaded lamp in my hand, it flew up against the chimney and fluttered around inside the shade. Then it perched on one of the brass arms of the shade; and when I reached in my hand to take it, it fluttered to the floor, where I grabbed it, and taking it to an open window set it on the window sill. There it squatted till I, in turning away, threw my shadow on it; and then in an instant it fluttered out into the darkness.

Shaowu, China, June 1, 1906. J. E. Walker.

Production of an Electrically Conductive Glass.

Experiments have from time to time been made, both in England and abroad, to ascertain what ingredients are best for the purpose of producing glasses of very high electrical resistance.

The utility of a vitreous substance which would conduct electricity comparatively well does not appear, however, to have so far claimed any consideration.

Attention should be directed to a glass which has recently been made in my laboratory. Its chief feature is that it really conducts electricity.

For the windows or cases of electroscopes and all high-tension apparatus requiring a transparent cover capable of screening off external electrical fields, this material offers many advantages. A conducting varnish is no longer required for glass which conducts electricity itself. In addition to these practical considerations, there arises the interesting question as to the process by which electricity passes through this substance—whether it is electrolytic. Its resistance varies very markedly with temperature changes. The basis of the glass is sodium silicate.—Charles E. S. Phillips in Nature.

A Mosquito Brief.

The American Mosquito Extermination Society has recently published a brief on the subject of mosquitoes which is worth repeating on account of the practical condensed information given. The card is illustrated with the various phases of the generation of the mosquito as well as of the common and fever-communicating species. It states:

1. There are over one hundred species of mosquitoes in the United States.

2. Mosquitoes breed only in water. They may breed in any kind of quiet water unstocked with destroying fish.

3. Mosquitoes generally require from one to three weeks to develop from eggs to winged insects in warm weather; longer in cold weather. Some female mosquitoes three days old lay eggs; the average is greater. Some species lay as many as three or four hundred eggs at once, some lay them singly. Mosquitoes may live several months (as shown by hibernation and otherwise), but probably few live over a month.

4. Mosquitoes do not breed in grass, but rank growths of weeds or grass may conceal small breeding puddles, and form a favorite harboring place for adults. The pitcher plant holds sufficient water to breed a rare and small species.

5. Different species of mosquitoes have as well defined habits as different kinds of birds, flies, etc. Some are domestic, some wild, some migratory.

6. Most domestic mosquitoes breed in fresh water, fly short distances, and habitually enter houses.

7. Most migratory mosquitoes breed in salt and brackish marsh areas, and fly long distances. They are not conveyors of malaria.

8. Rigid tests, both direct and eliminative, have proved that certain species of mosquitoes are the only known natural means of transmitting malaria and yellow fever. Some other diseases are known to be conveyed by mosquitoes.

9. Of the domestic varieties, the dangerous malarial mosquitoes (several species of the genus *Anopheles*) are among the most generally distributed. They seem never to travel far, only a few hundred yards.

10. A most common and dangerous domestic mosquito in the South and the tropics is *Stegomyia fasciata*, which is the natural conveyor of yellow fever.

11. Mosquitoes are known to bite more than once, as can be seen by observation and is proved by the transmission of disease from an infected person to a new subject.

12. Mosquitoes are a needless and dangerous pest. Their propagation can be largely prevented by such methods of drainage or filling of wet areas, removal, emptying, or screening of water receptacles, spraying standing water with oil where other remedies are impracticable. Attention should be paid to cisterns, house vases, cesspools, road basins, sewers, watering troughs, roof gutters, old tin cans, holes in trees, marshes, swamps, and puddles. As malarial mosquitoes may be bred in clear springs the edges of such places should be kept clean, and they should be stocked with small fish. The breeding and protection of insectiverous birds, such as swallows and martins, should be encouraged. Thorough screening of houses and cisterns is necessary to prevent the spread of malaria or yellow fever. The continued breeding of any kind of mosquitoes, with the attendant menace to public health and to the life and comfort of man and beast, is therefore the result of ignorance or neglect.

The Current Supplement.

As a valuable example of modern bridge construction the Thebes (Illinois) railway bridge deserves more than passing attention. In the opening article of the current Supplement, No. 1600, Mr. Charles Alma Byers discusses the structure. Good illustrations accompany his text. Some valuable statistics are published on the production, imports, and exports of iron and steel. Two new processes in color photography have been developed in Germany, which are known respectively as pinachromy and pinatype. They are not only of interest to the student of chemistry and physics, but are distinct and important advances in the reproduction of objects in their natural colors. These processes are ably described by Mr. H. A. Metz. Another curious photographic process is that which is known as the ozobrome. In this process a bromide may be combined with a carbon print with permanent and valuable results. Mr. F. R. Coles writes entertainingly on candlesticks of other days. Prof. Ray Lankaster's presidential address delivered to the British Association is continued. In this installment he concludes his discussion of radium and radio-activity and gives a general review of progress in chemistry, astronomy, geology, and animal and vegetable morphography. Some remedies and preventives against house flies are published. Felix Erber writes on the mysterious planet Saturn. An instructive article is that on the nutritive value of cereal breakfast foods. Emil LeLong gives a very good illustrated explanation of chain-making machinery.

REVIEW OF THE ATLANTIC FLEET BY THE PRESIDENT.

It takes but a glance at the names of the forty-five ships of the Atlantic fleet which will be reviewed by the President at Oyster Bay on September 3 to realize that this is by far the most formidable assemblage of American warships that has figured on an occasion of this kind. In the various squadrons and divisions will be found representatives of all the latest types of the warships of the United States navy, from the great "Louisiana" of 16,000 tons displacement down to the weird and ever-mysterious submarine of 120 tons. Incidentally the review will serve to present in concrete form a history of the growth of our navy during the past fifteen years. The fleet will be remarkable also because of the fact that it will include not a single ship that can be called strictly obsolete; for the "Indiana" and "Iowa," which date respectively from 1891 and 1893, are sufficiently up-to-date to form very valuable elements in the defense of our coast line and harbors. With the exception of the monitor "Puritan," which, although originally commenced in 1875, was not completed and put into commission until 1896, the oldest fighting ship in the fleet will be the "Indiana," whose keel was laid in 1891, and which received its first commission in 1895. The most important ships (and this is particularly true of the battleships and armored cruisers) have been built since 1901, and the most formidable of these have been put in commission during the past twelve months.

Looking at the fleet as a whole, one is impressed with the very gratifying fact that the bulk of the displacement is made up of battleships and armored cruisers—the types which must fight and win the battles of the present day. With the exception of the "Minneapolis," there is fortunately in the fleet no evidence that our naval constructors and naval secretaries have been afflicted with false ideas as to naval strategy—not, at least, as regards the possibility of winning naval campaigns by hunting for and destroying an enemy's maritime commerce. First and last, the winning of individual sea fights, and the successful prosecution of naval campaigns, will lie with the nations which can put upon the high seas the largest number of well-armed and well-protected battleships and cruisers. If the recent Russo-Japanese war taught one lesson more than any other, it was surely this; and it was only when the flower of the Russian navy, consisting of its latest and most powerful battleships, had been sunk or captured in the Sea of Japan, that the Russian government was willing to consider terms of peace.

The fleet that will gather at Oyster Bay on September 3 will consist of twelve battleships, four armored cruisers, four monitors, four protected cruisers, six destroyers, six torpedo boats, two submarines with their tender, a troopship, provision ship and water ship, and three colliers. By far the most formidable of the battleships is the 16,000-ton "Louisiana," which has recently been completed and placed in commission. With her armament of four 12-inch, eight 8-inch, and twelve 7-inch guns, she is probably the most heavily armed battleship afloat to-day, her only close competitors being the two British ships "Lord Nelson" and "Agamemnon," which, on about the same displacement, carry four 12-inch and ten 9.2-inch guns. Next to the "Louisiana" in power are three battleships of the "Georgia" class, the "New Jersey," "Virginia," and "Rhode Island." These vessels are of about 15,000 tons displacement and all have developed on trial more than their contract speed of 19 knots an hour. Each carries the same armament as the "Louisiana," except that the secondary battery consists of twelve 6-inch in place of twelve 7-inch guns. They are easily distinguishable from the "Louisiana" by the fact that four of the 8-inch guns are mounted upon the roofs of the turrets of the 12-inch guns, a device which also appears in the sister ships "Kentucky" and "Kearsarge," vessels of 11,520 tons displacement and between 16 and 17 knots speed. In the latter ships the main battery of 13's and 8's is carried in two double turrets on the center line, while the battery of fourteen 5-inch guns is mounted in a central broadside battery protected by 5½ inches of armor. About 1,000 tons larger than the "Kentucky" and "Kearsarge" and with nearly two knots higher speed, and the advantage of having been built some four years later, the battleships "Maine" and "Missouri" must be considered to be greatly superior. Each carries four 12-inch guns in two turrets on the center line of the ships, and a powerful broadside battery of sixteen 6-inch guns.

The "Maine" and "Missouri" are improved designs based upon the plans of two other battleships which will figure in the review, namely, the "Alabama" and the "Illinois," each of which is 11,552 tons displacement, and 17½ knots speed. They carry four 13-inch guns in two turrets and a secondary battery of fourteen 6-inch guns mounted in broadside within the central redoubt. When the plans for the "Maine" and the "Missouri" were first drawn, it was decided to give them the same size, displacement, and speed as the "Alabama" class; but, fortunately, as the result of an agitation against building battleships of such low speed as 17 knots, it was decided to lengthen these ships so as to accommodate larger engines and boilers and a more numerous 6-inch battery. The "Alabama" and "Illinois" are easily recognizable by the fact that they are the only American battleships which carry their funnels abreast of each other. The other two battleships in the fleet will be the "Indiana," one of the first three battleships to be built under the modern construction period of our navy, and the "Iowa," an improved "Indiana." The "Indiana" is a little over 10,000 tons trial displacement, has (or rather had) a speed of 15½ knots, and she mounts an armament of four 13-inch, eight 8-inch, and four 6-inch guns. The "Indiana" and her sisters were the first American battleships (or battleships of any nationality, for that matter) to introduce the system of mounting a secondary battery of heavy guns in four turrets at the four corners of the central redoubt—a plan which has excellent tactical features, since it renders it possible to deliver an unusually heavy all-round fire. One great fault in the "Indiana" class was that for the heavy battery that was carried the ships were altogether too small and the freeboard too low. In the "Iowa" the freeboard was raised by the construction of a forecastle deck, the 8-inch guns in four turrets were retained, and 12-inch guns were substituted for the 13-inch.

Unquestionably the handsomest group of vessels at the review will be the four large armored cruisers of the "Georgia" type, namely, the "West Virginia," "Pennsylvania," "Colorado," and the "Maryland." With their great length of over 500 feet, their graceful sheer, and impressive row of lofty smokestacks and towering masts they are, to our thinking, the handsomest warships afloat upon the high seas to-day. They are of absolutely identical design, and carry about the same coal supply and the same armament; hence they will have all those advantages in action which come from homogeneity. The later vessels of this type, of which the "Washington" and "Tennessee" are the first, will differ from them to the extent of having about 1,000 tons more displacement, and of carrying four 10-inch in place of four 8-inch as the main battery. This represents a great increase in power, and will render these vessels capable of taking their place in the first line of battle.

Of the four monitors, the "Puritan," although about double the size of the other three, is the least formidable, her guns and armor being of an earlier type of low penetration and resistance. Although the "Nevada," "Florida," and "Arkansas" mount only two 12-inch guns against the "Puritan's" four, they are more efficient weapons with higher velocity and greater penetration. It is certain that no more of the monitor type will be built, their low freeboard rendering them quite unfit for anything but harbor defense and such operations as can be carried out in still water.

Among the protected cruisers the "Minneapolis," whose keel was laid just fifteen years ago, will loom up large and apparently formidable. She is chiefly remarkable for the fact that she is the fastest cruiser in our navy, or to speak more correctly, she is credited with having made the fastest speed on trial, averaging 23.1 knots per hour. She was built as a commerce destroyer, and her armament is, therefore, very light, consisting of only one 8-inch and two 6-inch guns, besides some smaller rapid-firers. She is an expensive vessel to run, and in the present day, when there are armored cruisers of other navies afloat that greatly exceed her present speed, she is regarded in our navy as something of a white elephant. The other three protected cruisers, the "Tacoma," "Cleveland," and "Denver," vessels of 3,200 tons, 16½ knots speed, carrying ten 5-inch guns, are comfortable little craft that were designed more particularly for peace duties in foreign waters. For modern purposes their battery is too light, and their protection insufficient; consequently they would not figure largely in any future naval campaign, being too weak for effective fighting against modern armored craft, and altogether too slow for scouting purposes. It is certain that the type will never be repeated.

A feature of the review that is sure to excite the interest of the public will be the large number of destroyers and torpedo boats that will be present, there being altogether a dozen of these fleet little craft under orders to take part in the pageant. The six

THE ATLANTIC FLEET TO BE REVIEWED BY THE PRESIDENT AT OYSTER BAY, SEPTEMBER 3, 1906.

No.	Name.	Type.	Displacement, Tons.	Speed, Knots.	Coal, Tons.	GUNS. 13 in.	12 in.	10 in.	8 in.	7 in.	6 in.	5 in.	4 in.	3 in.	Small Guns	ARMOR. Belt.	Deck.	Turrets.	Casemates.	Torpedoes.	Keel Laid.
1	Maine	Battleship.	12,500	18	1,875		4				16			6	18	11 in.	2½ in.	12 in.	6 in.	Two—18 in.	1899
2	Missouri	"	12,500	18.2	1,825		4				16			6	14	11 "	2½ "	12 "	6 "	Two—18 "	1900
3	Kentucky	"	11,520	16.9	1,500	4			4			14			38	16½ "	2¾ "	17 "	5½ "	Four—18 "	1896
4	Kearsage	"	11,520	16.8	1,500	4			4			14			34	16½ "	2¾ "	17 "	5½ "	Four—18 "	1896
5	Louisiana	"	16,000	18.8	2,200		4		8	12				20	28	11 "	3 "	12 "	7 "	Four—21 "	1903
6	Rhode Island	"	14,948	19.5	1,700		4		8		12			12	30	11 "	3 "	12 "	6 "	Four—21 "	1902
7	New Jersey	"	14,948	19.5	1,700		4		8		12			12	30	11 "	3 "	12 "	6 "	Four—21 "	1902
8	Virginia	"	14,948	19.5	1,700		4		8		12			12	30	11 "	3 "	12 "	6 "	Four—21 "	1902
9	Alabama	"	11,552	17	1,275	4					14				30	16½ "	2¾ "	14 "	5 "	Four—18 "	1896
10	Illinois	"	11,552	17.5	1,275	4					14				28	16½ "	2¾ "	14 "	5 "	One—18 "	1897
11	Indiana	"	10,288	15.5	1,475	4			8		4				29	18 "	2¾ "	15 "	5 "	One—18 "	1891
12	Iowa	"	11,346	17.1	1,650		4		8				6		30	14 "	2¾ "	17 "	5 "	Two—14 "	1893
13	West Virginia	Armored Cruiser.	13,680	22.2	1,950				4		14			18	30	6 "	4 "	6½ "	6 "	Two—18 "	1901
14	Pennsylvania	"	13,680	22.4	1,825				4		14			18	30	6 "	4 "	6½ "	6 "	Two—18 "	1901
15	Colorado	"	13,680	22.2	1,825				4		14			18	30	6 "	4 "	6½ "	6 "	Two—18 "	1901
16	Maryland	"	13,680	22.4	1,950				4		14			18	30	6 "	4 "	6½ "	6 "	Two—18 "	1901
17	Puritan	Monitor.	6,060	12.4	306		4						6		10	14 "	2 "	8 "			1875
18	Nevada	"	3,225	13	338		2						4		13	11 "	1½ "	10 "			1899
19	Florida	"	3,225	12.4	355		2						4		13	11 "	1½ "	10 "			1899
20	Arkansas	"	3,225	12	344		2						4		13	11 "	1½ "	10 "			1899
21	Minneapolis	Provision Cruiser.	7,350	23.1	1,400				1		2				17		4 "		4 in.		1891
22	Tacoma	"	3,200	16.6	675							10			15		2½ "				1900
23	Cleveland	"	3,200	16.5	675							10			15		2½ "				1900
24	Denver	"	3,200	16.8	675							10			15		2½ "				1900
25	Whipple	Destroyer.	433	28.2	177									2	6					Two—18 "	1899
26	Worden	"	433	29.9	177									2	6					Two—18 "	1899
27	Truxton	"	433	29.6	177									2	6					Two—18 "	1899
28	Hopkins	"	408	29	154									2	5					Two—18 "	1899
29	Lawrence	"	446	28.4	110										7					Two—18 "	1899
30	MacDonough	"	430	28	110									2	5					Two—18 "	1899
31	Wilkes	Torpedo Boat.	165	26	66										3					Three—18 "	1899
32	Tingey	"	165	25	70										3					Three—18 "	1899
33	Rogers	"	142	24.5	44										3					Three—18 "	1896
34	Stockton	"	200	25.8	79										3					Three—18 "	1899
35	Blakeley	"	196	25.6	73										3					Three—18 "	1899
36	DeLong	"	196	25.5	72										3					Three—18 "	1899
37	Porpoise	Submarine.	120	8—5																Five—18 "	1900
38	Shark	"	120	8—5																Five—18 "	1903
39	Nina	Tender.		11.1	80																1865
40	Yankee	Troopship.	6,225	12.5	1,100							8			10						1892
41	Celtic	Provision Ship.	8,000	10.5	*										2						1891
42	Arethusa	Water Ship.	6,200		†										1						1893
43	Abarenda	Collier.	4,670	9	3,400										8						1892
44	Lebanon	"		10	1,800																1894
45	Leonidas	"	4,242	8.5	2,200										1						1898
						20	38		73	12	158	66	24	150	645					84	

* Celtic carries 2,500 tons of supplies. † Arethusa carries 850,000 gallons of water.

destroyers are of the general type that did such good work for the Japanese in the late war, although they are somewhat larger in displacement. The trial speeds ranged from 28 to 29.9 knots an hour, and each is armed with two of the formidable 18-inch Whitehead torpedoes. The torpedo boats are of the first class, with a displacement of from 142 tons in the "Rogers" to 200 tons in the "Stockton," and the speeds average about 25½ knots an hour. Last, and in point of spectacular interest, perhaps, the most attractive to the layman, will be the two submarines "Porpoise" and "Shark." They represent a method of naval warfare which, after a long and discouraging struggle for recognition, has now established itself, and promises to figure very largely in such future naval operations as concern the attack and defense of fortified harbors and roadsteads.

Finally, there will be seven auxiliary ships, including the "Yankee," a troopship of over 6,000 tons; the 8,000-ton Celtic—a provision ship capable of carrying 2,500 tons of supplies; the 6,200-ton water ship "Arethusa," whose tanks can hold for the use of the fleet 850,000 gallons of fresh water; and the three colliers, "Abarenda," "Lebanon," and "Leonidas," which between them can carry 7,400 tons of coal for the replenishing of the bunkers of the warships.

Summing up the fleet as a whole, the total figures are decidedly impressive. The forty-five ships represent a total displacement of 274,251 tons, carrying in its bunkers and in the holds of the colliers a total of 41,881 tons of coal. In the whole fleet are mounted twenty 13-inch, thirty-eight 12-inch, seventy-three 8-inch, twelve 7-inch, one hundred and fifty-eight 6-inch, sixty-six 5-inch, twenty-four 4-inch, one hundred and fifty 3-inch, and six hundred and forty-five rapid fire and machine guns. For torpedo attack there are carried about one hundred 18-inch and 21-inch torpedoes. The fleet will be assembled under Rear Admiral Robley D. Evans, as commander-in-chief, who will hoist his flag on the battleship "Maine," and the personnel will include 812 officers and 15,235 men.

Humanity and Machinery.

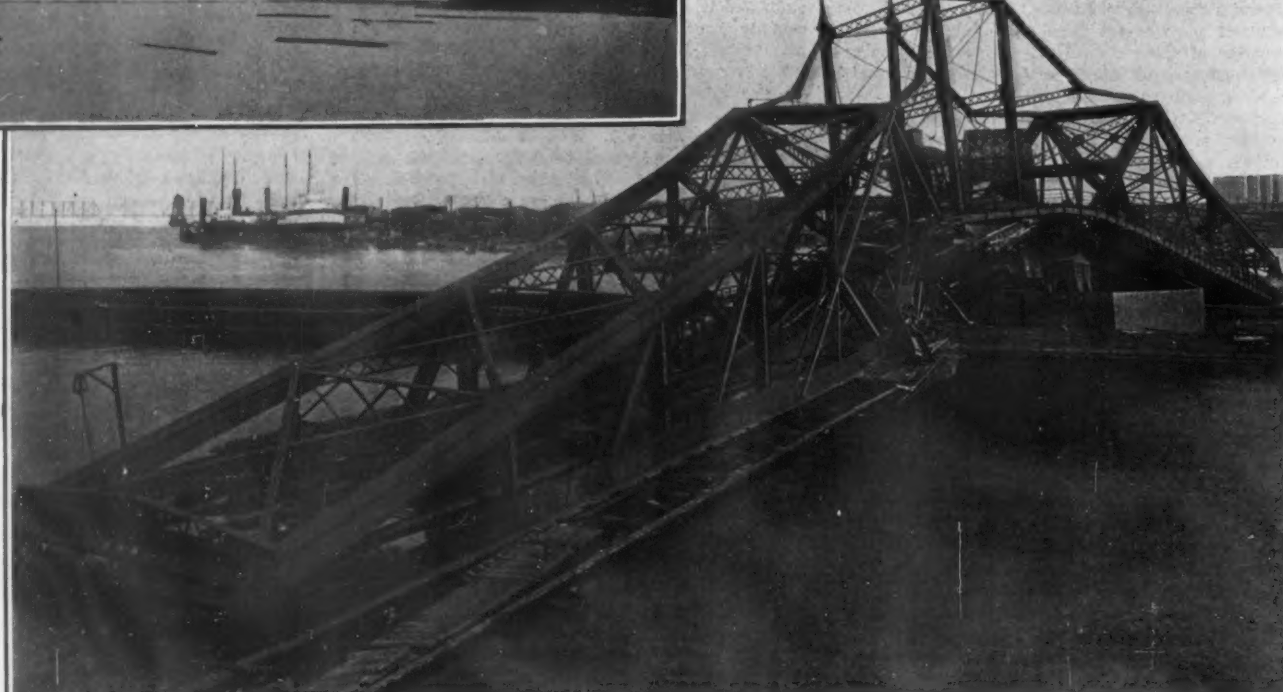
Machinery is the cornerstone of modern society, the very foundation on which law, science, ethics, the arts, even the state itself, rests. It is so new that we do not yet know its poetry. We do not yet understand. Only two generations have lived beside the highway of steam; only one has seen the Bessemer converter transform the blacksmith into a master builder of ships and towers. The sewing machine, the far speaker, the typewriter are common things of to-day, accepted as a matter of daily convenience, and yet are they teachers of the people. Machines that come close to our lives and homes insensibly teach truth, precision, the adjustment of universal laws to human needs, respect for that wise American idea that labor saved is labor released for higher and nobler toil. The machine is the head master of the high school of the race.—Reader Magazine.

WRECK OF THE DULUTH-SUPERIOR DRAWBRIDGE.

The two photographs which we publish of the important Duluth-Superior Bridge, otherwise known as the Interstate Bridge, show with very dramatic effect that a structure of this kind, in spite of its great size, weight, and apparent stability, is only strong and stable when the stresses applied to it act directly in the planes of the trusses and along the axes of their various members. They also show how great is the momentum existing in a large steamship even when, as in the present case, the speed has been reduced almost to the stopping point—a lesson which should be taken well to heart at the present juncture, when the question of the best location of the Panama locks is under active discussion.

The Interstate Bridge was built in the year 1893, and consists of two large shore spans, and a center draw span with a length over all of 500 feet (which renders it one of the largest, if not the largest draw span in the world), the clear opening for shipping on each side when the span is swung clear for traffic, being 220 feet. The accident occurred on August 11, at 1 o'clock in the morning, and was due to collision with the structure of the steamer "Troy" of the Western Transit Company. The steamer was approaching the draw slowly, and although the captain noticed that the operator on the bridge was tardy in opening the same, he continued under a slow bell in the expectation that, as is usually the case, the span would be swung clear with a rather small margin of time for the passage of the ship, this, according to his statement to the press, having been the common practice. When he discovered that the collision was inevitable, he backed his engines, the effect of which was to slow down the ship, and swing her bow from the center to the side of the channel, with the result that she struck the draw span about 20 feet from the central pier on the Superior side. It is easy to see from the photograph the nature of the collapse. The stem of the steamer struck the bottom chords (which, of course, at this point are members that are always in compression), cutting through them and causing that arm of the draw to sag into the river. The other arm followed suit almost immediately, the whole draw span settling into the position shown in the photograph. The impact of the ship was sufficient to push the whole structure over on its bearings, throwing the heavy supporting frame of girders below the central tower, and the turntable, out of plumb. One immediate effect of the disaster was to completely tie up both the water traffic in the harbor and the land traffic across the bridge itself.

Judging from the interviews given in the local press, it would seem that very grave chances have been taken in the use of this draw span, both on the part of the bridge crew and of the ships that pass through. Where masses of such great total weight have to be moved, it is courting disaster to allow only a small margin of time between the opening of the draw and the passage of the ships; and this is a fact which holds true, not merely in connection with this structure, but in others of equal importance that are to be found spanning our great waterways. A limit of distance should be imposed, nearer than which no ship should approach an important draw until it is swung entirely open and the channel is clear for passage.



The Vessel, Moving Very Slowly, Struck the Span Near the Center Pier. Her Stem Cut Through the Lower Chord, and the Two Arms Sagged Into the River.

WRECK OF THE LARGE DULUTH-SUPERIOR DRAW SPAN, 500 FEET LONG, BY A COLLIDING STEAMSHIP.

The Hair an Indicator of Health.

A Japanese physician, starting with the fact that illnesses exercise a notable and well-known influence upon the growth of the nails both in length and thickness, asked himself if the hair too might not be affected by sicknesses. The result of his investigations is, that every general illness diminishes the diameter of the hairs. The medullary layer may even be wanting, and it happens to the peripheric hard envelope to disappear. The influence of illnesses is sometimes more marked in the races or the individuals that have coarse, thick hair. In this case, it is easy by the inspection of a hair to know if the person who furnished it has recently passed through a general illness. The hair is made thinner along a part of its length, and the length of the thinned part is proportional to the duration of the illness. We can, therefore, say whether the illness has been long or short, and almost to a week indicate the duration which it has had. That is a fact that may have importance, e. g., in a question of identification. From the biological point of view it is, moreover, interesting to find that a hair behaves like the nails. But that was to be expected.—L'Illustration.

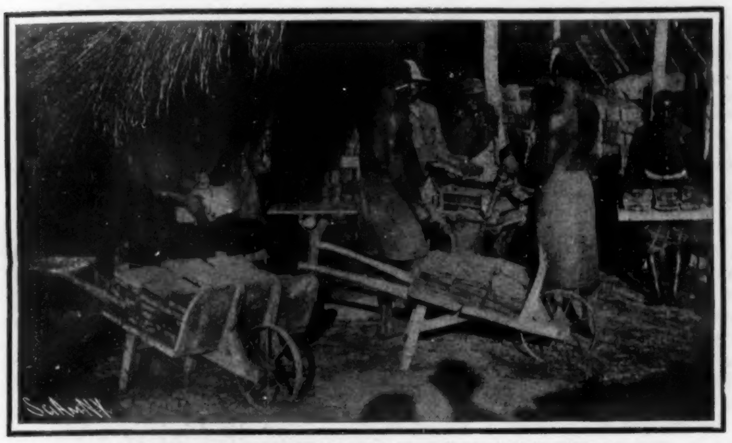
Duration of Flashes of Lightning.

We possess as yet only pretty vague data as to the average duration of flashes of lightning, says L'Illustration. Faraday thought he could fix it at a second. Dufour claimed that the flashes of lightning were instantaneous, and that their rapid succession gave the illusion of one flash of a certain duration. Herr Schmidt has just been devoting himself to a series of observations, employing a disk of ten centimeters diameter bearing upon a black ground a white cross, the arms of which were two millimeters across, the disk being set in motion by clockwork with a speed of 50 to 60 revolutions a second. At certain flashes, the cross appeared a single time, very distinct; the duration of lightning was, therefore, inferior to the time of revolution of the disk, which would represent about the fiftieth of a second. In more numerous cases, the cross appeared two or three times, or even more, but with a decreasing luminous intensity; the lightning had, therefore, lasted during several revolutions of the disk.

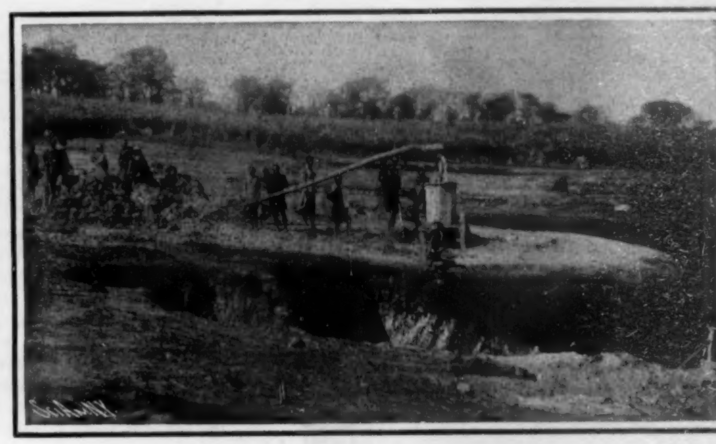
BRICK AND TILE MAKING IN THE TROPICS.

BY C. C. FULLER.

Many readers of the SCIENTIFIC AMERICAN are familiar with the primitive "adobe," or sun-dried, bricks and the process of making them. Such bricks are extensively used to-day in many countries where the climate is dry and heavy rains are almost unknown. In the tropics, however, the annual rainy season makes their use impracticable except in very small buildings, where they can be entirely protected by wide verandas.



An Immense Shed of Thatched Grass Protected the Bricks.



The Pug Mill Stood Between the Pits.

The brickmaker in the out-of-the-way districts, under the conditions in Rhodesia and most tropical countries, is confronted by a serious problem, into which a number of elements enter, such as the enormous cost of installing modern machinery, the lack of skilled labor, occasional torrents of rain even in the dry season, and, in many places, the poor materials available.

Throughout South Africa, outside of the modern cities, a kind of hand-made "slop" brick has been used for many years by both Dutch and English colonists, and many fairly substantial buildings are built of them. But with the introduction of modern machinery and methods into the cities, there has grown a demand for better bricks in the back-country districts, especially from those accustomed to the advanced methods in the United States, and here and there small machines have been installed.

It is only eleven years since the American Gazaland Mission was established at Mount Silinda in the mountains of southern Rhodesia, about 200 miles inland from Beira on the east coast and 150 miles south of Umtali on the Beira and Mashonaland Railway, which connects at Salisbury with the Cape to Cairo Railway. The isolated position, and consequent great expense of transporting supplies, made it necessary to use materials on the ground in the construction of the mission buildings, and common "slop" brick were used in all the older ones. Necessity, the mother of invention, led to the manufacture of flat shingle tiles, made entirely by hand, which are fairly satisfactory for roofing purposes, but very easily broken in comparison with the pressed tiles used in Europe and America.

Three years ago the writer was sent out by the American Board of Commissioners for Foreign Missions to establish here an industrial department, something after the pattern of the well-known institution at Lovedale, Cape Colony, or our famous American school at Tuskegee, Ala. Early in 1904 preparations were begun for making bricks and tiles for the first workshop, and as the building was larger than any of the earlier ones, and must carry some heavy machinery, it was necessary to make a better brick than previously had been used. A small pug mill of English manufacture had been for some time the property of the mission, and among the industrial equipment was a hand brick repress made in Cleveland, Ohio.

After They Were Dried the Bricks Were Placed in the Kiln.

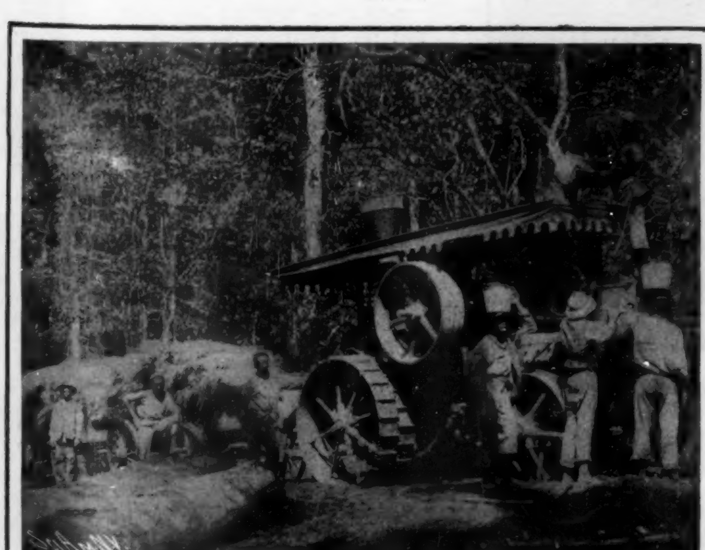
We are fortunate in having fine clay for both brick and tiles, but the deposits are some distance from the mission station, which necessitates hauling either clay or the finished product about two miles. Both methods had been used, but we decided to make the brick at the pit, and so dug a ditch more than 3,000 feet long through the dense forest and jungle, to bring water from the near-by stream to the molding tables.

In April and May, before the close of the rains, we cleared the rank growth of grass, weeds, and vines from the field, and built an immense shed of poles thatched with grass, to protect the bricks after they were dry enough to put into the kiln. Test holes were sunk, the little pug mill set up, and everything made ready for beginning work at the end of the rains. Early in June active operations were begun. Two pits were opened, using the clay from them alternately, as in this way it could be dug up during the day and the pit filled with water from the ditch; then, by the following day, the clay was well soaked for pugging.

The pug mill stood between the pits, and the clay was carried to it in ordinary hods, the first ever seen in this part of Africa. Under usual conditions a horse or mule would operate the mill, but here neither was available, as this climate generally proves fatal to either within a few months. Donkeys were to be had, but we found them too slow, so used two to four "boys" instead, changing them frequently and experiencing little trouble. Of course, they grumbled at our making *isimbongolo* (donkeys) of them, but really they had about the easiest work on the field.

The difference between American and English machines is well illustrated by this pug mill, which simply pugs the clay and discharges it unmolded, while the corresponding American machine would force it out in form to be cut into bricks by a wire or knife.

After coming from the pug mill the clay was tramped by the bare feet of a boy or two, and then taken to the molding tables. The usual way is to temper the clay by turning a lot of cattle into the

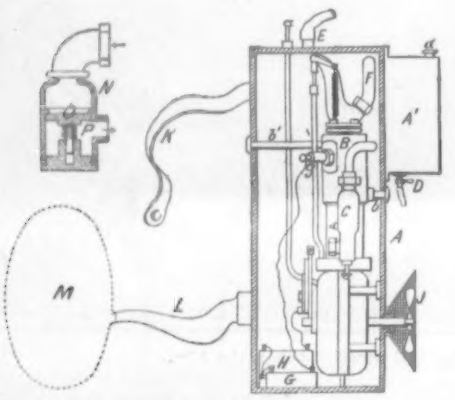


The Traction Engine in the Jungle.

Scene at the Molding Tables.

BRICK AND TILE MAKING IN THE TROPICS.

pit, and driving them around until it is well mixed. At the tables the molders press the clay by hand into the wooden forms, two or three bricks to the form, using water liberally. Boys carry the forms to the field, which is dug up into long parallel rows, smoothed off very carefully on top, and just wide enough for the bricks in one form. It is quite a trick to shake the soft clay free from the form without spoiling the bricks. In fact, they are usually rough and irregular. Here is the great difficulty in the South African "slop" brick, and just here our



Details of the Motor.

little repress made a vast improvement possible. In the usual practice the wet bricks are covered with grass and allowed to dry slowly, until beyond danger of cracking in the sun. Then they are dried as fast as possible, and when a few thousand are ready they are put into a kiln and burned.

We allowed them to dry under cover for five or six days, then we repressed them and stacked them loosely in piles to finish drying. Two molders averaged nearly 4,000 brick daily, and by putting four of the best men on the repress, we were able to take care of them. One man with wheelbarrows wheeled the bricks from the field to the machine, and two carried them away to dry, making seven men engaged in repressing. The record run for both molding and repressing was approximately 5,000 in a day of little more than nine hours.

This is commonly supposed to be a land of cheap labor, and the cost of manufacturing may be of interest. The molders were paid $10 per month, the best men on the repress $6.25, ordinary laborers $4.25, and boys $1 to $3 per month without food. About thirty men were employed, and the bricks cost approximately $4 per 1,000 when burned, not taking into consideration the loss in burning.

Repressing costs nearly 30 cents per 1,000, and easily doubles the value. Our brick are the wonder of all the district, and others say they will try to duplicate them.

The manufacture of tiles is very similar, but far more difficult and not so satisfactory. The clay was put through the mill three times, well tramped by boys, then worked thoroughly by hand, and molded into thin cakes 1 inch x [illegible] inches x 12 inches. These must be kept very carefully covered, and repressed at just the right stage, in order to make perfect tiles. It required two extra heavy men on the lever of the repress to secure sufficient pressure, and 800 per day was about the limit. After repressing, the tiles are again covered with grass till they are quite dry. The cost in the kiln was about $10 per 1,000, but later losses brought the final cost up to nearly $20 per 1,000, and even at that price they were only about half the cost of iron roofing delivered here.

About 90,000 bricks and 16,000 tiles went into the kiln which was much larger than any before attempted in this district, and for this reason was not sufficiently burned. The consequent loss of bricks was small, but the loss of tiles was about 45 per cent, notwithstanding 6,000 were successfully reburned in the face of the assertion by old brickmakers that it could not be done.

The breakdowns and repairs were what might be expected in any country 150 miles from a repair shop, and need not be recounted here. It is hoped that tiles may be made much more successfully this season, as we have made some improvements in the dies. Possibly other readers of the SCIENTIFIC AMERICAN working under similar conditions may find in these experiences some suggestions of value.

The world's production of Portland cement has increased from 2,500,000 tons to some 11,000,000 tons in the last twenty years, and the center of the industry has shifted from Europe to the United States.

THE SCREW-PROPELLED SWIMMER.

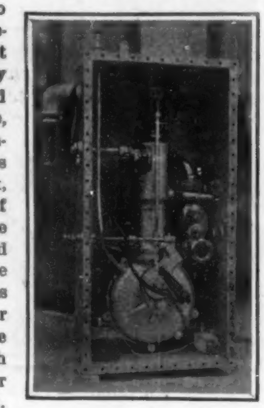
BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

M. Constantini, of Paris, after having been successful in adapting a gasoline motor to a roller skate, which we illustrated not long ago, now brings out another use of the motor in the form of a life-saving apparatus or automatic swimming device which can be used for sport as well. Bathers, for instance, can take exercise with the apparatus along the coast. Such an apparatus must be as light as possible, and precautions must be taken so that the motor will work under water in all conditions. A good distance can be covered, even by a novice, which distance is only limited by the size of the fuel tank.

We show three pictures of the life-saving apparatus as it is now constructed. In the first view it is in complete shape, with the exception of the air-bags, which serve as floats. The second view shows the inside of the case with the front cover removed, in which we observe the arrangement of the motor, carbureter, and ignition device. The main body or case of the apparatus consists of a light aluminium box about 20 inches high which is adapted to be carried upon the back of the swimmer. It is just large enough to contain the motor and the rest of the apparatus. The propeller, *J*, which is used to drive the device through the water, is mounted on the end of a crankshaft, and the latter is made to project out through a water-tight packing in the side of the case. To protect the propeller from any shocks it might receive, it is surrounded by a conical piece, carrying a wire gauze covering. The crank for starting the motor is fitted in the usual way upon the projecting end of the motor-shaft. At the top of the case is a pipe, *E*, over which is fitted a rubber pipe going to a float bag (which is not seen here), and this bag serves at the same time to supply the air which is required for working the carbureter during the time when the box may be sunk below the surface of the water. This is only for emergencies, however, and in general the carbureter takes the air through a suitable pipe from the outside. A set of valves controls the air supply in these cases. For cooling the motor cylinder, which is jacketed at the upper part, the water comes from the outside and leaves the box again through suitable openings on either side of the case. Gasoline is supplied from an aluminium tank, A^1, of square section, which is fitted against the back of the case. Below the gasoline tank is placed the outlet valve, *D*, and the rubber hose on this valve is connected in turn to a pipe upon the box, which leads by a metal pipe to the carbureter. To control the working of the motor, two rods pass

A WATERPROOF CASING CONTAINING A GASOLINE MOTOR WHICH DRIVES A SCREW IS STRAPPED TO THE SWIMMER'S BACK AND PROPELS HIM THROUGH THE WATER.

to the outside. One of these works upon the carbureter to regulate the proportion of gas and air for the mixture; the second rod acts upon the ignition shifting. The exhaust of the motor passes to the outside by the pipe, *b*. To it is connected a special form of muffling-box, which is shown in the section. It is provided with a valve, *O*, which is kept pressed up by the spring when the exhaust ceases. This has been designed so as to prevent the water from entering the exhaust pipe when it is submerged below the surface. Attached to each side of the main case is an air-bag of some size which serves as a float. The swimmer is seated upon a projecting saddle formed of a metal plate covered with cork, *L*. The saddle is hinged to the box in order to fold it up when not in use, and at the outer end is attached an air-float which can be of any convenient size. Two straps are fixed to the upper end of the box so as to fasten it upon the swimmer's back. At the lower end the straps are fastened in place by a hook or a button projecting from the box. The storage battery and induction coil, which are not seen here, are stowed in the lower part of the case under the motor. In order to use the life-saving device, the swimmer first starts up the motor by means of the hand crank from the outside, and, after seating himself on the saddle, puts the box upon his back, holding it by means of the straps. After the air-bags have been filled up, he goes into the water. He regulates the speed of the motor by the two rods we mentioned above, which act upon the carbureter and on the ignition. Steering is done by opening the hands more or less, or inclining them at different angles. Upon reaching the shore, he stops the motor by cutting off the gas supply and the ignition.



The Cover of the Motor Removed.

The Chimera of the Commercial Synthesis of Foods.

BY PROF. TH. BOKORNY.

For some little time certain of the carbohydrates have been included in the list of substances that can be made artificially, in the laboratory. I do not allude to the commercial manufacture of glucose, on an immense scale, from starch, nor even to the possible production of glucose from still another carbohydrate, the cellulose of wood. I refer to certain preparations which are yet little known outside of a small body of specialists; for example: Butlerow's "methylenitan," Loew's "methose," "formose," and "isoformose," and Emil Fischer's "α-acrose," which have been built up by synthesis from much simpler organic compounds. Just as plants, aided by sunlight, construct carbohydrates from atmospheric carbonic acid, or from formaldehyde, methyl alcohol, etc., so chemists have produced sugars or carbohydrates by agitating formaldehyde with excess of hydrate of lime, or by heating it with magnesia.

But the commercial production of these synthetic sugars will long be economically impossible, owing to the competition of the plants and the sun, which work far more cheaply than man. Cane sugar is worth five or six cents a pound at retail. What hope is there for producing it synthetically at such a price? Potato starch costs less than two cents a pound. The synthetic production of carbohydrates at these prices will scarcely be possible until we have found a way of utilizing solar energy as economically as it is utilized by chlorophyl—and we are yet very far from such a consummation.

Only a very bold and rash spirit can dream that the manufacturing chemist will, within any conceivable period of time, supplant the former as a purveyor of food.

A sober review of the actual facts leads to a very different conclusion. Consider, for example, the cost of converting the albumen of meat into somatose—that is to say, into the substances known to the chemist as albumoses or propeptones. Although somatose is only a slightly *simplified* albumen, it costs ten times as much as the very albumen from which it is derived, and a hundred times as much as vegetable albumen. There have recently appeared, even in popular journals, reports of the synthetic production of albuminoids in the laboratory of the eminent chemist Emil Fischer, of Berlin. From the considerations given above, however, it would appear that this synthesis is likely to have as little immediate practical value as is possessed by the earlier synthesis of carbohydrates.

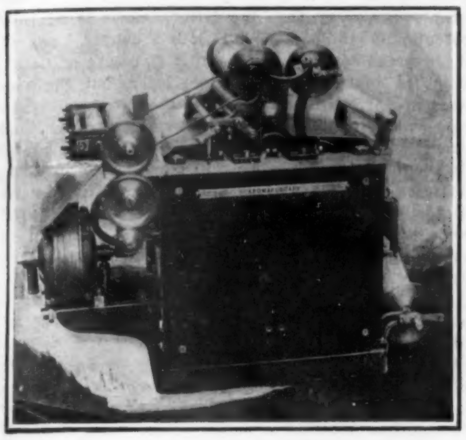
In regard to foods, the task of chemistry will continue to be the study of their chemical constitution and structure, the knowledge of which is of inestimable value in medicine and biology.

The synthetical production of foods is not at present a problem worthy of the attention of serious-minded chemists.—Translated for the SCIENTIFIC AMERICAN from Umschau.

THE KROMAROGRAPH—AN AUTOMATIC MUSIC-RECORDING APPARATUS.

BY DR. ALFRED GRADENWITZ.

While the phonograph affords a means of recording the spoken word or a sound, and the modern methods of mechanical writing, both stenographically and by means of the typewriter, enable language to be fixed graphically at the same speed it is spoken, a device for registering the notes produced by a musical instrument has so far been wanting. Such an apparatus would be of universal value to the composer, because



The Kromarograph.

in transcribing his composition to paper much time is lost and the creative power thereby impaired.

None of the numerous attempts made of late years to construct an apparatus of this kind has been successful, owing to the complication of mechanism and to the illegibility of the records. A machine invented by Mr. Laurenz Kromar, of Vienna, Austria, which has been exhibited at the International Musical Exhibition recently held in Berlin, seems to solve the problem satisfactorily. Readily connected with any type of keyed instrument, it automatically records the notes played in characters which closely resemble ordinary notes, and which are most easily read or transcribed. The apparatus works without any disturbing noise, is about the size of a typewriter, and is operated by electricity.

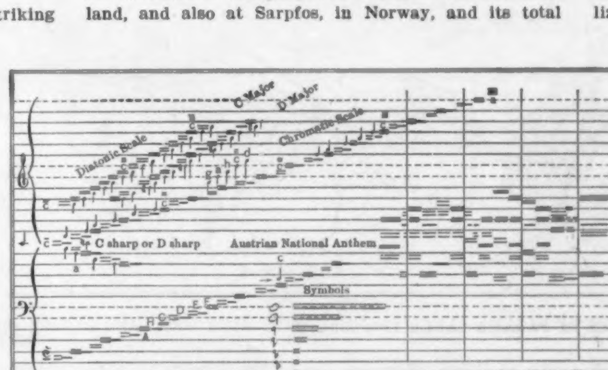
As seen in one of our illustrations, the most striking part of the apparatus is a set of rollers operated by a small electric motor, which rollers uniformly carry a paper tape over the types. As the keys are pressed down the types are actuated by an ingenious system of eighty-seven electro-magnets (each controlled by one key). The type corresponding with the key is attracted with extraordinary precision, registering its corresponding note on the tape of paper as it runs past.

The motor is driven either by direct or alternating current at 110 volts, its operation being controlled from the musical instrument by the aid of special contacts. Owing to the arrangement of the types and special provision for the upper and lower keys, each note accurately falls on or between the lines.

The note system of the kromarograph, as the machine is called, closely resembles the usual system of note-writing, the treble and bass of the five-line system being retained. The reading of eighth, sixteenth, and thirty-second notes is facilitated. Each white key corresponds with a double dash and each black key with an intermediary single dash of greater thickness. C-sharp and D-flat, D-sharp and E-flat obviously coincide in the new system, corresponding as they do with the same key of the piano, while their harmonical signification in the composition will be apparent. As soon as a note has been recorded, the ruling roller automatically continues the ruling, so as to prevent any displacement of the notes.

The tempo is marked by a number of rhythmical dots corresponding with the tempo dashes of the ordinary note writing system, these dots being produced in the course of playing, not automatically, but rather according to the player's discretion by means of a special pedal.

The length of notes and rhythm of the tune are recognized by the length of the dashes produced by the types, which length strictly corresponds with the duration of the pressure on the key, a short touch leaving a short dash, and a prolonged touch a longer dash. Because of the uniform motion of the tape, the length of dash accurately corresponds with the duration of notes, while gaps between two subsequent dashes represent the lengths of interval. If the same tempo is maintained, the rhythm will be readily ascertained even without the dots referred to above, while each *ritardando* results in a lengthening, and each *accellerando* in a shortening of the length of dash. Not only any details as to the touch and cadence, but any inaccuracies in the performance will be faithfully reproduced in the record. *Staccato* will be inferred from the shortness of dashes and the length of pauses, and *legato* from a succession of dashes without interval. A *glissando* will be characteristically reproduced by a dotted line, which is the more approximately vertical as the speed of playing is greater. *Arpeggios* and trills are likewise rendered in some characteristic way.



Record Made by the Kromarograph.

THE KROMAROGRAPH, AN AUTOMATIC DEVICE FOR THE RECORDING OF MUSICAL IMPROVISATIONS.

Transmission of Rabies by a Scratch.

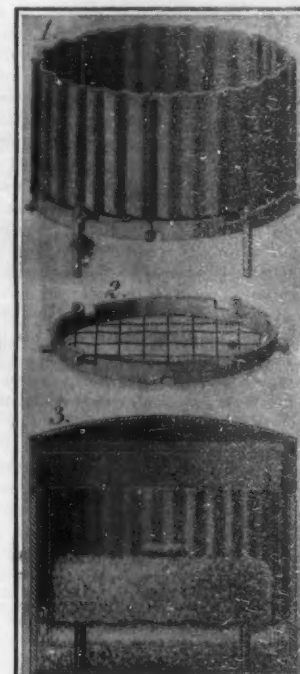
It is a popular and most erroneous notion, that hydrophobia appears in consequence of biting, and more rarely in consequence of licking surface wounds. There is also a third and easy mode of contamination—by scratching. Dr. Remlinger, of the Institute of Bacteriology, Constantinople, has just published several observations that indubitably establish the existence of such an origin of the hydrophobic infection. And this origin is easily explained. A certain number of animals (the dog and the cat in particular) have, in the normal state, a habit of licking their paws. Now, it has been proved that the saliva of rabid animals is virulent several days before the appearance of the first symptoms of hydrophobia. When the disease is declared, a new factor intervenes. The rabid animal scatters on the ground slaver that, especially if it be chained up or confined in a close place, soils its paws and its claws. On the other hand, the scratch lays bare numerous nervous fibers upon which the poison is very easily sown. Conclusion: Every person scratched by an animal rabid or suspected of being so should be inoculated by the Pasteur method with as little delay as possible.

The Aluminium Production of the World.

A report has recently been prepared by Mr. Guenther, American Consul-General, on the output of the various aluminium-producing works. The figures as given in the Chamber of Commerce Journal are as follows: The Aluminium Industry A.G., with works at Neuhausen, Switzerland, Land-Gastein, Austria, and Rheinfelden, produce 3,675 tons per annum. The British Aluminium Company has works at Foyers, Scotland, and also at Sarpfos, in Norway, and its total estimated annual output is 2,250. The Société Electro-Metallurgique Française produces 2,325 tons per year at its works at La Praz and Les Sordrettes. The other French company, the Société des Produits Chimiques d'Alois et de la Carmargne has works at Calypse and St. Felix, whose combined output for one year is given as 2,100 tons; but we understand that the French works were recently closed for some months owing to a strike. The Pittsburg Reduction Company, of Niagara Falls, Shavenigan, Canada, and Massena, is stated to have a combined output of 4,200 tons.

AN IMPROVED PUFF BOX.

Pictured in the accompanying engraving is an improved form of puff box designed with a view to overcoming the objectionable features of the ordinary puff box. In articles of this character as heretofore made, the puffs normally rest in the powder, and are consequently liable to pick up an excessive amount. The new puff box, however, normally holds the puff out of contact with the powder, but in such a manner that the user may, at will, press the puff down sufficiently to take up only the desired amount of powder, thus preventing bringing too much powder to the face, and also avoiding waste or the mussing of dressing gowns, dressing tables, and the like, by spilling the surplus powder. The construction of the improved box will be clearly understood by reference to the illustrations. It consists essentially of a ring-shaped cage (Fig. 1) and a puff rest (Fig. 2). These are assembled in a casing or box, as best shown by the section view (Fig. 3). The puff rest consists of a rim supporting a netting. The rim is adapted to fit against the bottom of the cage. The cage is preferably corrugated and several of the corrugations are utilized for housing spiral springs. The springs are secured at the top to the cage, while their lower ends are hooked to lugs on the puff rest. Secured to the cage are several vertical rods which extend below the bottom of the cage, serving as legs to space it from the bottom of the puff box. The puff rest is formed with guide arms which fit against these legs. The bottom of the box is filled with powder and the puff normally lies in the netting of the puff rest. In use the puff is pressed down more or less into the powder according to the amount desired to be taken up. The illustration shows the puff in its normal position, while in dotted lines its depressed position is indicated. It will be understood, of course, that the springs return the puff rest to its normal position as soon as it is released. If desired, any surplus powder may be removed from the puff by rubbing it against the corrugations of the cage. A patent on this improved puff box has recently been secured by Mr. Eugene A. Bagby, Waverley Hotel, Louisville, Ky.



AN IMPROVED PUFF BOX.

In a paper read at the annual convention of the Canadian Electrical Association, H. W. Buck, chief engineer of the Canadian Niagara Power Company, has this to say about the insulators which are used at Niagara: The insulators are made of a compound known as electrose. This material is a very good insulator, is very strong mechanically, and is entirely free from cracks and other defects which are common in glass and porcelain. Similar insulators have been used on the Buffalo transmission lines of the Niagara Falls Power Company for the past three years, and they are the only insulators on those lines which have caused no trouble. It is impossible to shatter electrose insulators by stone throwing, and they will frequently turn a rifle bullet without being damaged seriously. The conductor used on this line is of aluminium of 500,000 C. M. in section and having thirty-seven strands.

The sections of the Shanghai-Nanking Railway to Su-chau and Wu-sieh, 91 miles, were officially opened on July 16, says the Times. It is hoped that the line will be completed to Nanking by the spring of 1908.

A NEW TYPE OF SIXTY-FOOT SUMMIT LEVEL CANAL FOR PANAMA.

BY W. F. CLEVELAND.

In the Scientific American of June 30 a brief outline of the proposition forming the subject of this article was published with an appended note by the Editor, referring to the rejected 60-foot level type adopted by the board of consulting engineers for comparison with the sea-level type, recommended to Congress for adoption in the majority report. It proposed a dam of moderate height at Gatun, and specified a second dam with locks at Bohio for the maintenance of its 60-foot summit level, and the control of the Chagres floods, by the usual dam and basin at Gamboa. The serious engineering difficulties discovered in the proposed foundations at Bohio were chiefly instrumental in compelling its abandonment, although the almost identical altitudes of Bohio and Gatun suggest a secondary reason.

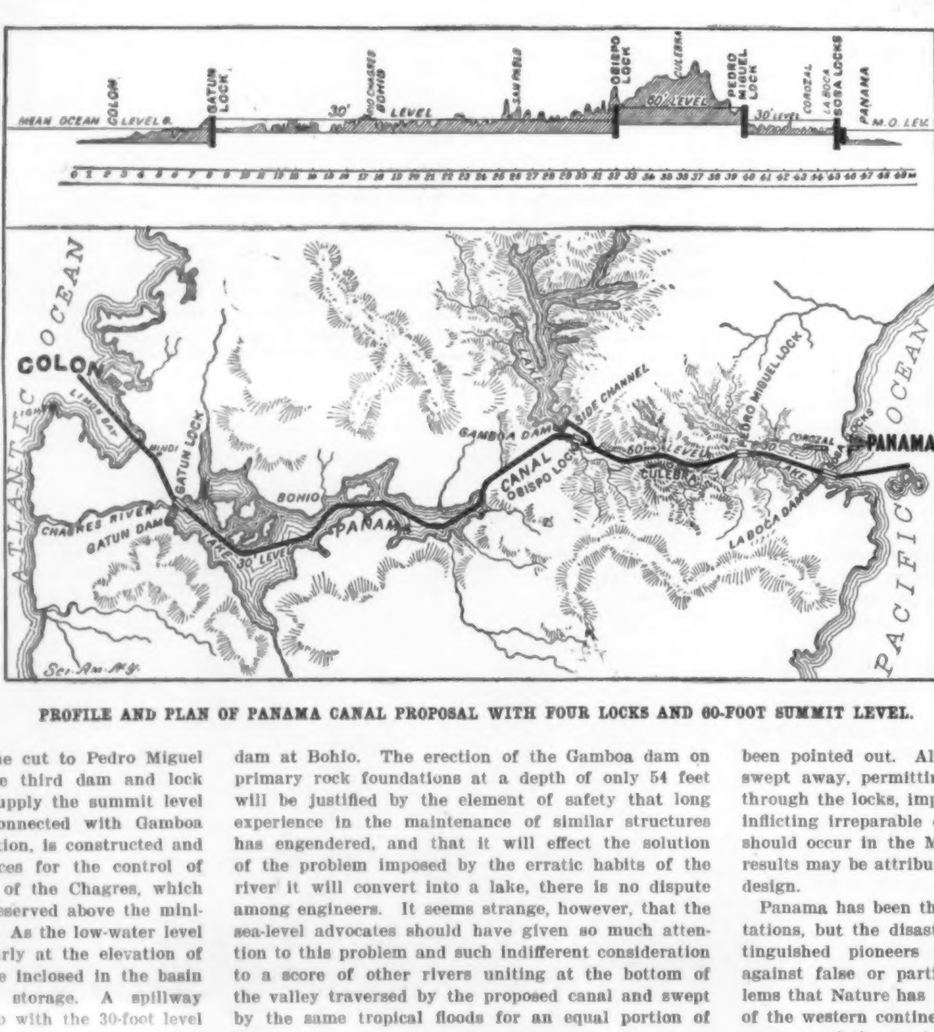
In seeking to evade these difficulties and a portion of the cost of the three great dams incorporated in this proposition, a minority of the engineers advised a colossal structure at Gatun for the maintenance of an 85-foot water level submerging the whole central valley of the Chagres, combining the three Atlantic locks in duplicate flight, and extending the location of the second lock site to Pedro Miguel on the Pacific slope. A strenuous controversy between the opposing engineers was thus precipitated and during the succeeding Congress the criticisms of the alternative type were continued with a vehemence and volume unprecedented in the annals of that august body, and resulted, contrary to general expectation, in the absolute rejection of the sea-level type. But although the chimerical character of a sea-level canal for Panama was satisfactorily exposed, its opposing lock type was shown to be far from perfect, and indeed some of the criticisms seem almost equally fatal and certainly should influence the administration to carefully consider the arrangement of the dams and locks which is shown in the accompanying illustration.

Beginning near Colon, the first eight miles of the canal will be constructed at sea level, 500 feet in width, as proposed in the recommended type. At Gatun the first dam and single-step lock (in duplicate) will be erected for the maintenance of a 30-foot water level, which will extend to the foot of the northern slope at Culebra. The second single-step lock (in duplicate) and dam across the artificial channel at Obispo will then change the water level to that of 60 feet, which is continued through the cut to Pedro Miguel on the Pacific side, where the third dam and lock site is located. In order to supply the summit level with water a side channel, connected with Gamboa basin as shown in the illustration, is constructed and provided with regulating sluices for the control of the variable levels and floods of the Chagres, which will be received in the space reserved above the minimum 60-foot level of the basin. As the low-water level of the river at Gamboa is nearly at the elevation of 60 feet, almost the entire space inclosed in the basin will be available for water storage. A spillway directly connected below Obispo with the 30-foot level also forms a part of the equipment at this point. If advisable a tunnel could be used instead of a side channel.

At Pedro Miguel the 30-foot level is again reached through a single step lock, also in duplicate, and here, as at Obispo, the cost of the equipment will be reduced to a minimum, as the artificial channel will only be encountered, probably with bed rock foundations at its bottom. Spillways will be necessary at both of these points for the discharge of requisite volumes of water from the summit level. Lake or broad channel navigation will then be resumed and continued to La Boca dam, where a single-step lock (in duplicate) at Sosa will connect with the tidewater of the Pacific, regulated for shipping by the proposed tidal lock at the head of the four and one-half miles of sea-level channel.

The work of dredging the channel across the terminal lakes could be done during the erection of the dams, beginning with the submerged sections in or near the river estuaries and avoiding deep-water dredging as far as possible by suitable regulation of the lake levels. Dry excavation will be necessary for two or three miles below Obispo until the flooding of the channel will permit of its completion by the use of dredges. The low-level sections of the canal will thus be inclosed by parallel embankments of dredged material, partially submerged for the greater portion of the way, marking the course of the channel, and protecting it from currents and floating or partially submerged obstructions. A submarine forest or jungle, such as will cover the beds of the lakes for many years after the completion of the canal, would soon cover the surface of an unprotected channel with water-soaked trees and rubbish, dangerous to shipping, and especially so to the propellers of steamships. It would be difficult to protect a high-level channel from such obstructions.

Practically all the free sailing advantages of the high-level canal will be retained. With suitably drawn contours, a channel from 200 to 300 yards in width will afford as safe and speedy navigation as any inland lake or river. A few miles above Bohio the channel will become more restricted than that proposed for the high-level canal, but the work of meeting all essential requirements throughout this section of the canal will not materially increase the outlay. Above the head of the lake, with the exception of the Chagres, there are no streams of any importance, and the proposed basin for the reception of its floods will serve, with equal efficiency, the purpose of the abandoned dam at Bohio. Nature seems to have had a definite object in view when she contrived the impossible foundations at this point. There was no need for a dam at Bohio. The erection of the Gamboa dam on primary rock foundations at a depth of only 54 feet will be justified by the element of safety that long experience in the maintenance of similar structures has engendered, and that it will effect the solution of the problem imposed by the erratic habits of the river it will convert into a lake, there is no dispute among engineers. It seems strange, however, that the sea-level advocates should have given so much attention to this problem and such indifferent consideration to a score of other rivers uniting at the bottom of the valley traversed by the proposed canal and swept by the same tropical floods for an equal portion of the year.



PROFILE AND PLAN OF PANAMA CANAL PROPOSAL WITH FOUR LOCKS AND 60-FOOT SUMMIT LEVEL.

At the close of the rainy seasons an enormous volume of water will be stored in the basin, supplying ample volumes for lockage throughout the annual droughts, and permitting the diversion of the surplus, through the regulating sluices and side channels, into the summit level, where the overflow will be divided, with the view to as large a discharge as possible at Pedro Miguel, as the lower level spillway at Obispo will increase the output at this point. The proposed dam at Alhajuela, intended for the storage of lockage water, forming part of the plans for a high-level canal, will not be necessary to the success of this project.

At Culebra cut the volume of excavated material in the 25-foot stratum below the bed of the high-level channel will impose an additional outlay, but the work will be confined within the limits of the navigable channel as the wide summit excavation of sliding material is demanded, regardless of the choice of plans. It will yield a direct return in the avoidance of two locks (in duplicate) with the cost of their operation and maintenance, and a much more important advantage in the adjustment of the conditions to the avoidance of locks in flight.

Locks in flight are the one serious innovation in the high-level plans. The outlay for land damages incurred in the submersion of large areas of fertile lands will be much greater, and the controversy concerning the permanency of the Gatun dam, impounding an additional depth of 55 feet of water, has reached a hopeless stage of opposing of irreconcilable convictions, but the former may not be a serious matter from the viewpoint of an opulent country, and it may be proper to say that the latter danger is at least potential in its character. If it is a danger, however, it threatens not only the gigantic structure at Gatun, with its double flight of triple locks, but the very existence of the canal itself. If the dreaded disaster ever comes there will be no canal at Panama, and America will be bowed in shame at folly that squandered the millions her discretion had saved from the pursuit of the chimera that humbled the national pride of a sister republic. Earth dams impounding a moderate depth of water are not an experiment even on foundations similar to those at Gatun, and America cannot afford to try one at Panama.

But the incorporation of a system of locks in flight at La Boca as well as at Gatun is a feature of the high-level plan that even its own advocates make little effort to defend. The first objection is the costly work of securing suitable foundations for them at these points, and especially at Gatun, where it seems that Nature has provided a subterranean peak of barely sufficient area. She seems to say to the engineers: Build one lock here and no more. But even if we are heedless of the suggestions of our great teacher, the use of such equipment is endangered by the fact that it has never been tried in the special service for which it is proposed. Locks in flight are an appropriate and useful feature of barge canals, and in similar service have yielded their designed efficiency for many years, but that the experience gained from such usage will be found almost wholly inapplicable to the work of handling ponderous battleships and ocean liners in such positions is evident. Those who have watched the process of docking one of these great ships will appreciate the difference in the character of the work imposed by their enormous bulk and momentum. The danger of crippling the canal by the destruction of one of the summit lock gates has been pointed out. All the succeeding gates might be swept away, permitting a torrent of water to sweep through the locks, impossible of control, and doubtless inflicting irreparable damage. That such an accident should occur in the Manchester canal without serious results may be attributed to its single-step or tidal-lock design.

Panama has been the sepulcher of engineering reputations, but the disasters that have overtaken its distinguished pioneers should warn their successors against false or partial solutions of the great problems that Nature has imposed at this strange coupling of the western continents. The world is watching the progress of the work, and the expenditure of a few additional millions, if such is necessary, will be small matter, so that it aids in securing the safety and efficiency of the canal. The delusions of the sea-level dream have been happily dispelled, and the choice of a lock type evidently superior to its surviving competitor is offered at the close of a destructive controversy, but still in plenty of time for adoption.

Aluminium Paper in Germany.

Aluminium paper is now manufactured in Germany, and recommended as a substitute for tin foil. The paper used is a sort of artificial parchment obtained through the action of sulphuric acid upon ordinary paper. The sheets are spread out and covered upon one side with a thin coating of a solution of rosin in alcohol or ether. Evaporation is hastened by means of a current of air, and the paper is then warmed until the rosin has again become soft. Then powdered aluminium is sprinkled upon it, and the paper subjected to strong pressure to fasten the powder thereon.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC CLOTH-CUTTER.—J. B. REPLOGLE, Chicago, Ill. This invention has for its more particular object the production of a power-driven cutter operated, preferably, by electricity. When the device is used for cutting comparatively thin layers of cloth only the lower baffle-plate is called into use. When a large number of layers are to be cut simultaneously, the machine is fed directly against the edge of the "stack," the several baffle-plates finding their way between the layers, each consecutive pair of plates preventing undue movement of such layers lying therebetween.

ELECTRIC TELPHER POSTAL SYSTEM.—R. T. PISCICELLI, Corso Umberto I. No. 23, Naples, Italy. The inventor's object is to provide devices, acting for the most part automatically, by means of which correspondence introduced in the posting-boxes in a postal district is rapidly collected and carried to the central office. This collection is effected by means of small vehicles driven by electric motors running over special aerial lines used exclusively for this purpose and made of insulated metallic wires or cables, which act as guides to the vehicles and conductors of the current.

TELEGRAPH - TRANSMITTER. — H. O. PUTT, Millbury, Ohio. As its principal object the improvement provides a device which can be mounted under the frame of an ordinary type-writing machine and operated thereby without in any way altering the machine, and which will accurately transmit the characters of the Morse or any other alphabet automatically and rapidly, and do away with many complications in transmitting characters by telegraph by the operation of a keyboard.

Of Interest to Farmers.

GATE-FASTENER.—J. HOLLOPETER, inventor, and P. R. GILES, assignee, Elsmere, Neb. The fastener is especially adapted for use on gates such as are formed in wire fences and which are not as frequently opened as ordinary gates. It refers to such gates as are formed without frames and which are maintained in position by a horizontal tension in the longitudinal members of the gate. It prevents the actuation of the fastener by cattle.

PLOW ATTACHMENT.—J. SPODEN, Clyde, Wash. This attachment is devised for pressing down or flattening wheat-straw stubble or grass on the furrow-slice as turned by the plow. To this end a ribbed roller is provided which is held rotatably on a swinging arm journaled on the plow-beam, the roller being adapted to work at such angle and in such proximity to the moldboard that it acts on the furrow-slice at its turning-point, so as to break, press down, or flatten the straw, stubble, or grass in such manner that it is buried in the furrow beneath the slice.

Of General Interest.

CORNER - FASTENING. — L. B. PRAHAR, New York, N. Y. The purpose of the invention is to provide means for connecting the members at the corners of a frame and in producing such result forming an opening at the junction of the corner members for the passage of a pin, rivet, or other required article.

COLLAPSIBLE MOLD.—C. W. OVERTURF, Dumont, Iowa. The broad idea characterizing the improvement is a peculiar mold adapted for use in the construction of plastic passage-ways, the same being constructed collapsible, whereby to facilitate its removal when the plastic is sufficiently set. It relates to molds for forming concrete or other plastic composition pipes, culverts, etc.

WELL-RIG.—S. S. STROTMAN, Haynie, Pa. This rig comprises means for bracing a structure in the direction from whence proceeds the driving force for the movable operative parts of the structure, means being also employed for controlling the reel upon and from which is caused to be wound and unwound the line or cable for the bail or other well-tool. The parts of the structure are easy of access, adjustable, and smooth running in operation.

CHARGING APPARATUS.—T. F. WITHERBEE and J. G. WITHERBEE, Port Henry, N. Y. The invention refers to a charging device for blast-furnaces and the like. The requirements of a charging apparatus at present are that it shall be capable of varying the manner of distributing the charge at will and that it shall be adapted to mechanical filling. The principal object is to attain these results. It is an improvement on the former patent issued to Mr. T. F. Witherbee, in 1894.

DAM.—G. E. LADSHAW, Spartanburg, S. C. This improved dam is a unitary structure comprising piers provided with buttresses and connected by arches springing from the piers upon the opposite sides from the buttresses. While the dam may be composed of a plurality of arches supported at their abutting ends by buttressed piers, it may be composed of a single arch with ends directly supported by abutments.

PAD FOR HORSE-COLLARS.—D. S. BROWN, Watertown, N. Y. Pads for use in collars and various similar places have been usually constructed by forming a sort of bag or by securing two sheets of fabric or similar material together at the edges and forcing curled hair or other cushion material into the same through an opening in the end or side. This results in making wads at certain places, and therefore produces irregularities in the softness of the pads. This invention overcomes these irregularities.

METHOD FOR TREATING ASBESTOS.—A. H. HIPPLE, Omaha, Neb. This is a process for treating asbestos so as to vulcanize the same. It is an improvement on a former patent granted to Mr. Hipple. In this case he takes asbestos fiber, powdered sulphur, and water and works the same into a pulp of the consistency used for making asbestos paper or millboard. The pulp being formed, pressure squeezes out a part of the water, and the mass is next dried. Oil is added and absorbed readily.

POLISHING-MITTEN.—R. E. HILLS and V. E. BREVOORT, Delaware, Ohio. The invention is an improvement in mittens intended and adapted for use in polishing shoes and other articles, the same being provided with two thumbs arranged contiguously so that a mitten may be worn on either hand and either palm serve as the polishing surface.

DIE-STOCK.—H. J. CARMODY, New York, N. Y. This invention relates to die-stocks—such, for instance, as are used in cutting threads upon rods, tubes, pipes, etc. Practical and convenient operating means are provided for threading a pipe located in some comparatively inaccessible position; also for cutting a thread upon a cylindrical bar which is more readily accessible; and also means if at any stage of cutting the device is desired to be operated backward.

TELEPHONE - DIRECTORY.—D. F. WHITCOMB, Cleveland, Ohio. Being in place upon the mouthpiece the directory in use is rotated thereon until the desired letter is at the right side. By means of an ear the plate may be partially withdrawn from the frame, thus bringing the subscribers' names under that index letter to view. Since the inner edge of each of the plates conforms to the arc of a definite circle, an outward pull on the ear belonging to that plate will have but slight tendency to move adjacent plates, since there will be more or less friction between the inner edges thereof and the sleeve.

Hardware.

NUT-LOCK.—L. W. LAYE, J. H. PHILLIPS, and J. BEVAN, Havre De Grace, Md. The patentees provide for the locking of the nut by slotting the end of the bolt and also forming a slot in the nut crossing the bore thereof. They pivot a hook latch on the nut at one side which may be swung into the slots of the nut and bolt and engage the side of the nut opposite the pivot.

KEY.—J. H. P. IRBOTT and W. R. YEARWOOD, New Amsterdam, Berbice, British Guiana. The invention relates to keys for locks, and has for its principal objects the provision of such a device which is normally incapable of performing its functions, but which may be readily manipulated or set by one familiar with its operation, so that it may be used in the customary manner.

Household Utilities.

COMBINED CHAIR AND STEP-LADDER.—A. M. WHITELEY and W. H. WHITELEY, New York, N. Y. The chair has a back suspended from which is an outwardly-swinging frame forming a brace for the back in outward position of the frame, the back and the rear supporting-legs constituting the ladder member capable of being tilted or carried. Back and rear legs are rigid with each other, but pivotally applied to the frame of the chair bottom, so that when the swinging frame is carried forwardly of the bottom the ladder member tilts for coöperation of the two. Means secure the swinging frame and ladder member to the bottom of the chair in each position thereof, and when the frame is carried to a vertical position the ladder member moves to corresponding position, the two becoming automatically locked.

COOKING APPARATUS.—W. E. BAXTER, Frankfort, Ky. In the present patent, the invention is an improvement in portable cooking apparatus, especially such as is intended for use in camping out, campaigning, and the like and which can be conveniently and compactly packed in shape for storage and carrying.

Machines and Mechanical Devices.

CHUCK.—L. A. WELLINGTON, Keene, N. H. The chuck comprises a body, jaws having recesses and which are mounted to slide with relation to the body, levers fulcrumed upon the latter and engaging the recesses, a ring movable upon the chuck-body provided with openings, and removable portions fixed in the openings and furnishing inclined faces for contact with the levers.

PITMAN.—A. M. AKIN, Spokane, Wash. The invention relates to pitmen, and especially to those designed for use in connection with agriculture-machines, such as headers and reapers, but may be employed wherever a connecting element of this character is desired. Its principal objects are to provide a device which may be readily adjusted to compensate for wear and effectively lubricated.

FIBER - CLEANING MACHINE. — F. S. MACY, Boston, Mass. This is an improved machine for treating fibrous plants—such as Manila hemp, ramie, maguey, sisal, and piña—for separating the fibers from the pulpy and gummy portions; and a special object the inventor has in view is the production of a machine distinguished for economy of construction and efficiency in work and operation.

MEANS FOR HARVESTING ICE IN THE FIELD.—F. E. LOSEE, Newton, N. J. An endless traveling cable is employed, together with suitable guides therefor, carried by supports erected at desired places of the field, means being used in connection with the cable by which the blocks of ice may be conveyed from the field directly to the shore. It is practically a conveying apparatus for the blocks of ice, and requires but few operatives in the field.

ANIMAL-RELEASING DEVICE.—W. A. IRWIN, Taunton, Mass. One purpose in this case is to simultaneously release all the animals in a line of stalls and at the same time turn on an individual spray on each to force them to leave the stalls and inclosure, the delivery mechanism for the spray being so arranged that in action the spray will reach the head and shoulders of each one, whether standing or lying down. The device serves to hold the hitching-straps in position for use, but when the water is turned on the straps will be simultaneously released.

PEANUT - STEMMING MACHINE. — P. D. GWALTNEY, Smithfield, Va. The roots or stems adhering to peanuts as dug from the ground require to be removed preliminary to storage, transportation, or preparation for the market, and this is ordinarily done by hand, which is slow, laborious and expensive. This simple machine performs such work effectively, quickly, and cheaply, without injury to the peanuts.

Prime Movers and Their Accessories.

TORSION-INDICATOR.—H. FÖTTINGER, No. 4 Pruts street, Stettin, Prussia, Germany. This improvement refers to an apparatus adapted to determine the rotary movements of power-driven shafts from their torsion in running and transmitting energy, the apparatus being based on the fact that in all qualities of malleable iron or steel the angle or arc of torsion is proportional to the actual rotary moment.

Pertaining to Vehicles.

TIRE-COVER.—W. A. ALLEN, New York, N. Y. One purpose of this inventor is to provide an effective cover for the tires of automobiles and other vehicles using rubber tires, which cover will fit snugly to the tire and conform to all parts thereof, the cover being so constructed that rain, snow, or hail will not beat in, but will be shed therefrom as soon as received.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 8322.—Wanted, electric massage or vibration machines.

Inquiry No. 8323.—Wanted, parties to make an attachment, in quantities, in the line of hasps and strap hinges.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10098) W. B. H. writes: I was given a question in a recent examination that the examiner stated was proved in a copy of your magazine; but he could not state the date the example appeared nor prove it himself. The problem read: "Do the amperes or volts increase when the electricity passes through an ordinary spark coil for gas lighting?" I said volts, yet my examiner says the answer is amperes, which I doubt. A. The volts are raised in the action of the ordinary spark coil in gas lighting. This coil has but one winding, no secondary. It is not an induction coil in the usual sense. The spark is produced by the self-induction of the current in the turns of the primary upon itself. This produces a higher E. M. F., which causes a considerable spark. There can be no more amperes in the circuit than the generator can produce.

(10099) J. K. asks: Please inform me why two telegraphic instruments will not work when set up in series. One of the instruments is a 4-ohm, and the other I think is larger. The larger one can be heard from another room, while the small one can hardly be heard at all. A. The smaller of the two instruments does not get current enough to work the magnet. In order to work together, they should have nearly the same resistance.

(10100) E. B. asks: 1. Have you any SUPPLEMENTS containing articles relating to the care and maintenance of the sal ammoniac battery used in telephone work? A. Cooper's "Primary Batteries" gives considerable space to the sal ammoniac battery. Price $4.00 by mail. 2. Can you recommend a book suitable for one who has to look after the repair of a telephone line? A. Hopkins's "Telephone Lines and Their Properties," price $1.50 by mail.

(10101) J. S. T. writes: I have been fitted with glasses to correct astigmatism. Without glasses the rays of an ordinary street lamp appear extended perpendicularly; with the glasses they appear longer the opposite way. If glasses were properly ground, should not the rays radiating from light appear of uniform length? A. If your astigmatism were perfectly corrected by the glasses, objects would be seen in their correct outlines.

(10102) W. A. P. asks: 1. Should an ampere-meter be placed in the positive or negative terminal of a direct-current 110-volt dynamo? A. The ammeter may be placed at any point whatever in an electric circuit, since the same current flows through every part of a circuit. This is just like the flow of water through a pipe. If you had a pipe 1,000 feet long from a reservoir to your house, the same water and just as much would flow through every foot of the pipe, and a meter might be put into the pipe at any point in its length and the quantity of water flowing through the meter to be measured. 2. How much more would it register in the former than in the latter? A. It would register the same in either side of the circuit. It makes no difference where the ammeter is placed.

(10103) B. A. T. asks: 1. How many pounds of wire are used to wind the armature of the electric motor described in the issues of the SCIENTIFIC AMERICAN for December 8 and 15, 1900? Also the field magnet? A. About a half-pound for the armature and the same for the field. 2. How many watts are necessary to run it at its utmost power? A. We do not know. Somewhere from 12 to 24. Four cells of 2-volt battery, put two on series, should run it. 3. Cannot other journal boxes than the brass balls mentioned be used, such as a block of iron smoothly bored? A. Yes, of course; any kind of bearings can be used.

(10104) A. E. S. says: May I ask you to kindly inform what chemical changes take place during the setting of Portland cement, plaster of Paris, and similar substances. A. Mortar, which is made of slaked lime and sand, when exposed to the air, slowly changes into carbonate of calcium, and the entire mass becomes extremely hard. The water contained in the mortar soon passes off. When limestones that contain magnesium carbonate and aluminium silicate in considerable quantities are heated for the preparation of lime, the product does not act with water as calcium oxide does, and this lime is not adapted to the preparation of ordinary mortar. On the other hand, it gradually becomes solid, in con-

tact with water, for reasons which are not known. Such substances are known as cements. Plaster of Paris is found in nature in the form of gypsum or anhydrite, and consists of calcium sulphate and water. A granular form of gypsum is called alabaster. Calcium sulphate is difficultly soluble in hot and cold water. When heated to 100 deg. Cent. or a little above, it loses all of its water and forms the powder known as plaster of Paris, which has the power of taking up water and forming a solid substance. The hardening is a chemical process, and is caused by the combination of the water with the salt to form a crystallized variety of calcium sulphate.

(10105) H. H. M. says: Would you kindly inform me if I could get an object to float that is heavier than the water it displaces? For instance, are these large ocean steamers heavier than the water they displace? A. If a rigid body or solid be immersed in a liquid, both being at rest, the resultant action upon it of the surrounding liquid is a vertical upward force called the "buoyant effort," equal in amount to the weight of the liquid displaced, and acting through the center of gravity of the volume of displacement. From this it will be readily seen that you cannot secure an object to float which is heavier than the water it displaces. In the case of the vessel, because of the particular form of the hull, the law of displacement remains the same. The weight of the water displaced by the hull equals the entire weight of the ship and its cargo.

(10106) J. D. W. asks: Can it be proved that a right angle can be trisected? A. The trisection of a right angle is a very simple proposition. The radius of a circle is equal to the chord of 60 deg. If the radius be laid off as a chord from one extremity of the arc of a quadrant, or the arc subtending a right angle, and a radius be drawn to the other extremity of the chord, the angle formed on one side will be 60 deg. and on the other side the angle will be 30 deg. or one-third of a right angle.

(10107) A. E. N. asks: Why do steam boilers explode when, through misfortune, a steamer sinks? A. The explosion of boilers in steamers that are wrecked is probably due to the sudden stopping of the engines and the abandonment of the fireroom by the firemen without the proper precaution to check the fires. It takes but a few minutes in such cases for the steamer to overbalance the outlet of steam from the safety valves, when the rise in pressure ruptures the boilers. When one explodes, others follow by damage from the exploded boiler.

(10108) G. J. R. asks: Can you give me the reason for the vibration in a motor or generator when the armature and shaft are balanced as nearly as possible? I would like to see what your opinion is in regard to it. A. The slightest excess of weight on one side will cause a perceptible vibration of an armature. As little as one-thousandth of the total weight will cause a very considerable vibration. If an armature is perfectly balanced, it will run so quietly that it is difficult to tell whether it is in motion or not. The process of balancing an armature is described in Crocker's "Electric Lighting," Vol. I., price $3 by mail.

(10109) C. H. W asks in reference to the answer to query regarding the attraction of a 5-pound and 15-pound mass upon each other. The mutual attraction between the masses is given by the formula $F. = K \frac{m\,m'}{d^2}$; and to this quantity the larger mass contributes three times as much as the smaller. It is true that this attraction acts upon both masses equally, and will give to each the same quantity of motion. In the case of the earth, when a body falls toward it, the earth also falls with the same quantity of motion toward that body. But the greater portion of the motion comes from the mass of the earth, since that is enormously greater than the mass of any body falling toward it, and therefore the small body moves much farther from this attraction than the larger one does.

(10110) H. L. B. asks: 1. Would you please tell me what produces the curly effect in bird's eye maple? A. We do not know how the mechanical forces act in the growth of the wood to produce the burls in the bird's eye. A while ago the question would have been answered, "It is the nature of the tree to grow that way." 2. Why is it necessary to only put ten 16-candle-power 104-volt lamps on a circuit? A. The amount of current which is allowed to flow through one cutout in a building is regulated by the rules of the Board of Fire Underwriters and is determined by the risk of setting fire should a fuse blow.

(10111) G. H. E. writes: In an informal conversation the statement was made that of the energy stored in a given amount of coal an extremely large proportion is lost in the attempt to employ it productively, as in the steam engine, and that the utilization of the energy wasted by the present methods is an important scientific and economic problem. This statement was challenged, and in the resulting discussion the following questions arose. 1. How large a proportion of energy stored in a given amount of coal is lost by methods commonly in use? A. From 20 to 25 per cent, and sometimes more, of the heat value of the coal is now lost. 2. At what stages in the process of transformation, and how, do the chief losses occur? A. Mostly by the heat going up the chimney, and to a small degree by bad stoking and radiation of heat from defective insulation of boiler setting and pipes. 3. What percentage of the energy in a given amount of coal can be (not is) used in producing steam? A. The possibilities for utilizing the full energy of coal are very small. Little may be expected over the best practice of to-day. It is the converting of the steam into active power wherein the trouble lies. 4. How is the amount of energy in a given amount of coal ascertained? A. The absolute amount of energy in coal is found, first by an analysis of its combustible constituents, from which the heat units are computed; second, by actual combustion of a given weight and measuring its heat producing property by absorption of the heat in water or by melting ice in a calorimeter.

(10112) J. A. M. writes: Will you kindly inform me whether the following facts are new, or only so to the writer? The mechanical equivalent of heat as given by Dr. Joule's experiment of a weight falling through air, actuating thereby wings in water, is 778 foot-pounds according to William Kent. Now you will note that the relative weights of water and air are as 1 to 774. Is there not an equation here between work, water, heat and air? Might not the slight variation of 774 and 778 pounds be due to the slip of the water? William Ripper gives the equivalent as 772 pounds. A. The mechanical equivalent of heat, which is called Joule's equivalent, as determined by Dr. Joule, was 772 foot-pounds. That is, to lift 772 pounds to a height of 1 foot requires the same amount of work as to heat 1 pound of water 1 deg. Fahr. This work was done between 1840 and 1843. Considering the advancement of mechanical science at that time it was a marvelous piece of work. He employed the friction of water and measured the heat produced. Joule also determined the equivalent by means of the electric current. Others investigated the same constant by other methods, the compression of metals, the specific heat of air, the induced electric current in metals, and the velocity of sound, with results fairly in agreement with that of Joule. Joule's method was that of direct determination of the number of foot-pounds of work used in actually heating one pound of water one degree. Other methods were indirect. That these coincided fairly well with the direct method was all that could be expected. All methods are open to errors, and more or less close approximations are all that could be attained. In 1879 Prof. Rowland took up the problem with the finest appliances of modern science. He employed water friction, as did Dr. Joule. His results were immediately accepted. Probably the work will not be done over again for a generation. Some of his results involved as many as 12,000 distinct observations. He proved that the mechanical equivalent varies with the temperature. Between 41 deg. and 68 deg. there is a change of nearly eight-tenths of one per cent in the latitude of Baltimore. The mean of Prof. Rowland's results is 778 foot-pounds, which for all ordinary purposes is at present considered the true equivalent. Prof. Rowland's experiments showed that the specific heat of water diminishes from 32 deg. to 84 deg., and then increases till the boiling point is reached. Rowland was able to produce a change of 63 deg. in the water where Joule could produce a change of only 1 deg. He also used the sensitive air thermometer instead of the slow mercurial thermometer.

(10113) An old subscriber says: I have several old daguerreotypes which until recently were in a good state of preservation. Now I find that the surface of the plate has apparently oxidized and the portrait has disappeared from view. Can you give me instructions for restoring the pictures and preserving them? A. The removal of the deposit from the surface of the daguerreotypes is such a delicate operation that, if possible, it should be intrusted to one who has had experience in that process. If, however, you wish to try it yourself, you may proceed as follows: Carefully separate the cover glass from the silver-coated plate, being especially careful that the surface of the latter is not touched even by anything so light as a feather. Soak the daguerreotype first in water, and then in a solution of potassium cyanide, from five to ten grains to the ounce; rocking the dish till the deposit is removed. A 20-grain solution of sodium hyposulphite may be used instead of the cyanide, although it is not always so successful. When the deposit has been removed, the plate should be well washed under a gentle stream from the tap, or in several changes of water, finishing with distilled water. The method of drying is important. The plate, after slight draining, should be taken by a corner by a pair of pliers and held over the flame of a spirit lamp or gas jet, allowing just sufficient heat to evaporate the remaining film of water, the evaporating of which may be assisted by gently blowing across the surface. The restored daguerreotype and cover glass, the latter after thorough cleaning, should then be bound together as before, and the more completely this is done so as to exclude the atmosphere, the longer will the image retain its pristine beauty. Potassium cyanide is a deadly poison. It should be used with care.

(10114) C. S. asks: About how much current does a ¼-inch spark coil take to give full length of spark? A. A good authority gives about 10,000 volts as the pressure required for a spark of ¼ inch. The current, or amperes, is insignificant. 2. Is a relay necessary, in wireless telegraphy? A. Yes. 3. Is it necessary to have oscillators on the coil in wireless telegraphy? A. Yes. 4. With good usage how long should an induction coil last? A. Forever. There is no deterioration by use in an induction coil. 5. Can you explain why a Geissler tube still glows when connected with only one wire of the secondary of the coil? A. Because of electrical induction. The waves go through space from one pole of a coil to the other. The Geissler tube held between the two poles of the secondary will glow when it is connected with neither wire. The same experiment can be performed with the bulb of an incandescent lamp. Hold it in the hand by the metal base between the terminals of the coil.

(10115) R. W. W. asks: 1. The object-glass of my telescope consists of two lenses, one being convex and the other concave-convex. When they are together they are the same as an ordinary convex lens. Why is a single one not used? A. The two glasses are used to prevent the objects seen from being bordered with a colored fringe. Remove the concave glass and you will see the difference. Then study in some textbook of physics about achromatic lenses. 2. Why is it that copper wire is used for electric lighting and power currents and iron or steel for telegraph and telephone wires? A. There is a very small flow of current in the telegraph and telephone wires, and a large flow over the lighting and power circuits. Copper is a much better conductor than iron, and though it costs much more in the first place, it is far cheaper in the end. 3. What is the difference between a continuous and an alternating electric current? A. A continuous current flows like a stream of water steadily in one direction. An alternating current flows by rising to its full voltage and then falling to its least. There are alternations of the electromotive force, which has all possible values in a series.

(10116) D. P. asks: Does electricity occupy space? A. No. Electricity is not ordinary matter, as, for example, lead is. Whatever it may be, it is not a material substance.

(10117) E. O. M. writes: I have two textbooks on physics which disagree. Mr. Spottiswoode, of London, had an induction coil made which gave a 42-inch spark. One says it required 5 Grove cells to give the 42-inch spark; the other says 30 Grove cells were required. Which is right? A. The statement in Gordon's "Electricity" is that with five Grove cells the coil gave a spark 28 inches long; with 10 cells the spark was 35 inches, and with 30 cells it was 42½ inches long. 2. What difference of potential was required to force the spark across the gap of 42 inches? A. We do not know. Probably hundreds of thousands of volts.

(10118) J. C. A. asks: Please inform me how to make a strong magnet of Jessop steel. I have tried to make some ½ inch square by 3 inches long, straight bars, by passing them through a spool of wire with a 300-volt current, by which they were strongly magnetized, but lost almost all magnetism in about three weeks. How can I make such magnets which will retain their strength for a long time? A. Heat the bars to be magnetized to a red heat and plunge them into water. They are then to be magnetized. Straight bars do not retain magnetism well. They should lie in pairs with opposite poles toward each other, side by side, not end to end, or else in pairs with an iron keeper across the poles. They may be laid four in a square with opposite poles against each other. Laid down alone without keepers, the magnetism is rapidly lost.

(10119) W. F. G. asks: Will vulcanized fiber answer for the insulation on static machines, and are vulcanite and vulcanized fibers identical? A. Vulcanized fiber will be but little better than wood as an insulator in this position. Vulcanite is hard rubber and is a different substance from fiber.

(10120) E. L. asks: 1. Can you tell me, without knowing the amperage, the voltage being 50 volts, if a 75-watt dynamo or 1-6 horse power as motor will light 5 lamps of 10 candle power at full capacity? A. Ten-candle lamps may be taken to be from 3 watts to 4 watts per candle. One lamp will consume from 30 watts to 40 watts, and 75 watts will light two such lamps. 2. What is the resistance of No. 16 iron wire? A. Pure iron has a resistance of 6 times as great as copper. Ordinary telegraph wire has a resistance 15 times as great as that of copper of the same size. No. 16 copper wire has 248.81 feet per ohm. Pure iron wire of the same size would have 41.47 feet per ohm, and No. 16 ordinary iron wire would have 16.19 feet per ohm. 3. If a current of 10 amperes at 108 volts goes through 540 feet of No. 16 iron wire, what will be the electromotive force and current remaining after it has gone through, and how to calculate it? A. There will be 10 amperes remaining. But there will not be any volts remaining, if the wire constitutes the entire circuit between the mains. The same amperes flow through the entire circuit and come out at the other end, just as the water flows through the entire length out of a pipe open at both ends and comes out at the other end. The drop of potential along a wire is proportional to its length, provided it is of uniform sectional area, as it may be presumed to be in this case. This being so, there will be a drop of one volt for each four feet along the wire. 4. Can we run a direct-current motor with an alternating current? The motor is not loaded. A. Yes; if it be started and brought up to synchronism with the current by hand, or by some other power. It will then keep step, and run by alternating current.

NEW BOOKS, ETC.

THE AMERICAN BATTLESHIP IN COMMISSION. By Thomas Beyer, U.S.N. Published by the Author. New York: Army and Navy Register. 12mo.; pp. 248.

The author of this work, Thomas Beyer, is a first-class ship fitter of the United States navy, an enlisted man who has given his views of the service. The amount of information contained in this book is certainly remarkable. The author begins with a general view of the organization of the navy, and then passes on to those subjects which laymen are most curious about. He tells, for example, how a battleship is prepared for a voyage; how it is handled at sea and in port; gives a clear picture of the daily life of the officers and men, and describes the drills of the week and their purpose. This chapter may be considered perhaps the most interesting in the book, inasmuch as it gives an enlisted man's own views of life on a man-of-war. The remaining portions of the work are devoted to chapters on the more material part of the bluejacket's life, such as the opportunities which the service offers him, his amusements and pastimes, the manufacture of ordnance and ammunition, the designing of a battleship. The last portion of the book is taken up with a collection of man-of-war yarns. The author is to be congratulated upon the praiseworthy manner in which the book has been issued. The illustrations are certainly the most interesting collection of pictures that we have ever seen. The typography is excellent. The book is one that we can heartily recommend for a good, clear, impartial account of the United States navy.

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Fertilizers, Georgia Chemical Works	55,927
Fertilizers, Virginia-Carolina Chemical Co. 56,093 to	56,095
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Liniment, A. B. Richards	55,713
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Lotion, S. R. Van Duzer	56,060
Lotions in liquid and paste form, skin, American Peroxide & Chemical Co.	55,656
Lotions, salves and ointments, Sereta Chemical Co.	55,649
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Lye, Pennsylvania Salt Manufacturing Co.	56,077
Lye, Pennsylvania Salt Manufacturing Co.	56,078
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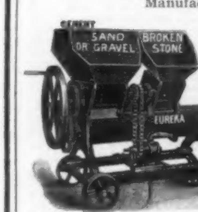

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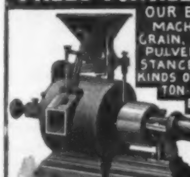

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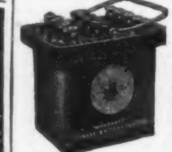

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